The Engineer.

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VOL. CLII.—No. 3947] LONDON: FRIDAY EVENING, SEPTEMBER 4, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

LIFT.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 22nd September, 1931, for DISMANTLING and REMOVING existing LIFT GEAR and the SUPPLY and ERECTION of an ELECTRIC LIFT at the Ministry of Health, Whitehall, S.W.

Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7478

City of Cardiff Education COMMITTEE.

THE TECHNICAL COLLEGE.

PRINCIPAL: CHARLES COLES, B.Sc. (Lond.).

DEPARTMENT OF ENGINEERING.

HEAD OF DEPARTMENT: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1931-32.

(Commencing on MONDAY, 5TH OCTOBER, 1931.)

The FOLLOWING COURSES have been ARRANGED for ENGINEERING STUDENTS:—

A THREE YEARS' COURSE in MECHANICAL and MARINE ENGINEERING jointly with the University College of South Wales and Monmouthshire.

A TWO YEARS' COURSE for APPRENTICES and OTHERS with facilities for Practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering, or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS covering tuition fees and maintenance grants of £40 per annum for three years, are OFFERED for COMPETITION ANNUALLY, and candidates for entry to the above Department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application Forms for entrance scholarships examination, duly filled up, must be received before September 10th.

W. J. WILLIAMS,
Director of Education.

City Hall, Cardiff. 7433

Heriot-Watt College, Edinburgh

DEPARTMENTS OF MECHANICAL ENGINEERING AND ELECTRICAL ENGINEERING.

MECHANICAL ENGINEERING:
PROFESSOR A. R. HORNE, O.B.E., B.Sc., M.I. Mech. E., A.M.I.C.E.
ELECTRICAL ENGINEERING:
PROFESSOR F. G. BAILY, M.A., M.I.E.E.
FULL-TIME DAY DIPLOMA COURSES leading to professional recognition.
CLASSES COMMENCE 12th OCTOBER.
Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal.
7175

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, LONDON, E.C. 1.

SCHOLARSHIPS IN ENGINEERING.

An Examination will be held on September 24th and 25th at the Polytechnic for the award of the following Scholarships:—

THREE SCHOLARSHIPS in ENGINEERING, value £18 per annum.

These Scholarships are tenable at courses extending over four years in Civil, Mechanical, Electrical or Aeronautical Engineering, and including ten months' practical experience in the works of large industrial firms.

For further information apply to
S. C. LAWS, M.A., M.Sc.,
7467 Principal.

CITY OF LONDON.

The Sir John Cass Technical Institute,

JEWRY STREET, ALDGATE, E.C. 3.

METALLURGY for ENGINEERS:

ALSO

EVENING UNIVERSITY COURSES.

The following COURSES MEET the REQUIREMENTS of ENGINEERS and those wishing to prepare for the degree of B.Sc. (Eng.) in Metallurgy of London University:—

GENERAL METALLURGY.
ELECTRO-METALLURGY.
METALLURGICAL ANALYSIS AND ASSAYING.
FUEL AND REFRACTORIES.
METALLOGRAPHY, PYROMETRY AND HEAT TREATMENT.
MECHANICAL TESTING OF METALS AND ALLOYS.
METALLURGY OF ENGINEERING METALS AND ALLOYS.
GEOLOGY AND MINERALOGY.

NEW SESSION COMMENCES SEPTEMBER 21ST, 1931.

ENROLMENT on and after September 16th, 5.30 to 8.30 p.m.

For details of the courses apply at the Office of the Institute, or by letter to

GEO. PATCHIN, A.R.S.M., M.I.M.M.
7466 *Principal.*

Herts. County Council.

WATFORD TECHNICAL SCHOOL.

SERVICES of a PART-TIME INSTRUCTOR for the Practical Work in the Engineering Shop of the Junior Technical School are REQUIRED for the week starting September 14th. Fares from London will be paid. P1457

The Engineer

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UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, are arranged for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL, and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS:

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering (Dean).
C. H. LOBBAN, D.Sc., M. Inst. C.E., Reader in Civil Engineering.
Professor J. K. CATTERSON-SMITH, M.Eng., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer in Electrical Engineering.
Professor G. COOK, D.Sc., M.I. Mech. E., M. Inst. C.E., Mechanical Engineering.
S. J. DAVIES, M.Sc., Ph.D., M.I. Mech. E., Reader in Mechanical Engineering.
H. W. CREMER, M.Sc., F.I.C., M.I. Chem. E., Chemical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the four Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 7412

PUBLIC NOTICES.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that JOHN CLIFFORD SAVAGE, of 28, The Ridgeway, Golder's Green, London, N.W. 11, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 313,634, granted to Cyril Ernest Randall, Leonard Robert Thompson and John Clifford Savage for an invention entitled "Improvements in or relating to Optical Apparatus for Projecting Illuminated Signs upon Screens."

Particulars of the proposed Amendment were set forth in No. 2223 of the Official Journal (Patents), published on August 26th, 1931.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
7464 Comptroller-General.

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING.

Mechanics and Mechanical Engineering:—
Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.;
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C., M.I. Mech. E.
Electrical Engineering:—
Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
Civil Engineering:—
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
Mining Engineering:—
Professor DANIEL BURNS, M. Inst. M.E.
Chemical Engineering:—
Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete Courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee, 25 guineas per annum.

SESSION 1931-32 BEGINS on TUESDAY, SEPTEMBER 22nd.

Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the SECRETARY.
7228

PUBLIC NOTICES

County Borough of Croydon.

EDUCATION COMMITTEE.
CENTRAL POLYTECHNIC—MECHANICAL ENGINEERING DEPARTMENT.

REQUIRED, TEACHER with broad workshop practice and sound technical training to teach Mechanical Science to apprentices on Wednesday evenings from 7.30 to 9.30, commencing 23rd September. Fee 15s. per evening. Applications, giving full particulars of education, practical training, teaching experience, present appointments, resident address, and age, should be addressed to the Principal, Central Polytechnic, Scarbrook-road, Croydon.

R. B. MORGAN,
Education Officer.
Education Office, Croydon. 7428

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.

Founded 1854 by SIR WILLIAM FAIRBAIRN.

Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

Borough of Chepping Wycombe WATERWORKS.

NEW SERVICE RESERVOIRS.

The Corporation of the above Borough invite TENDERS from contractors experienced in Ferro-concrete Work for the CONSTRUCTION and MAINTENANCE of TWO COVERED SERVICE RESERVOIRS as follows:—

Low Level (No. 1) at Bowerdean-road, High Wycombe, of a capacity of 2 million gallons; and
High Level (No. 2), at Widdenton Park Wood, Lane End, Bucks, of a capacity of 1 million gallons.

The contract will include the Construction of both Reservoirs in Ferro-concrete (Hennebique System), with Brick Valve Houses and all necessary Valves and Pipe Connections, &c.

Drawings may be seen at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, and copies of the specification, bills of quantities and form of Tender obtained upon depositing the sum of Five Pounds, which will be returned upon the receipt of a bona fide Tender.

The works are to be carried out in strict accordance with the conditions laid down for materials and labour by the Unemployment Grants Committee in respect to employment schemes, and the contractor will be required to undertake to make a commencement of the works immediately on acceptance of his Tender.

Sealed Tenders, marked "Tender for Service Reservoirs," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 28th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

P. B. BEECROFT,
Town Clerk.
Town Clerk's Office, High Wycombe. 7469

Borough of Chepping Wycombe WATERWORKS.

15IN. DIA. PUMPING MAINS.

CONTRACT NO. 2, MAIN LAYING.

The Corporation of the above Borough invite TENDERS from experienced Contractors for the CARTING, LAYING and JOINTING of about 9600 YARDS of 15in. Dia. STEEL PIPES (supplied by the Corporation), together with the PROVISION and FIXING of the necessary SLUICE VALVES, AIR VALVES and HYDRANTS, between the Pann Mill Pumping Station and the Bowerdean-road and Widdenton Park Wood Service Reservoirs, about to be constructed. The contract will also include the LAYING alongside the trench of the 15in. Main a CABLE for Electrical Recorders (supplied by the Corporation).

Drawings may be seen at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, and copies of the specification, bills of quantities and form of Tender obtained upon depositing the sum of Five Pounds, which will be returned upon the receipt of a bona fide Tender.

The works are to be carried out in strict accordance with conditions laid down for materials and labour by the Unemployment Grants Committee in respect to employment schemes, and the contractor will be required to undertake to commence the works immediately on acceptance of his Tender or as soon after as the pipes are available from the manufacturers.

Sealed Tenders, marked "15in. Dia. Pumping Mains, Contract No. 2, Tender for Main Laying," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 28th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

P. B. BEECROFT,
Town Clerk.
Town Clerk's Office, High Wycombe. 7471

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PUBLIC NOTICE

Government of Bombay.

NOTICE.

To IRRIGATION DEPARTMENTS, PORT AUTHORITIES, RAILWAYS, MUNICIPALITIES, ELECTRIC SUPPLY COMPANIES, PUBLIC WORKS CONTRACTORS AND OTHER ADMINISTRATIONS CARRYING OUT LARGE ENGINEERING WORKS.

Notice is hereby given that, owing to the approaching completion of the Lloyd Barrage at Sukkur, large quantities of Plant and Machinery as briefly detailed in the list below will shortly become available for sale. Most of the plant is now available.

All Administrations who have works in progress or who are contemplating works in the near future are invited to consider the subjoined list and to apply to the undersigned for full particulars and prices of any plant which might be of use to them. Enquiries are NOT invited from machinery dealers at the present stage. Most of the plant was purchased new for these works and is in excellent condition. Every item of plant sold will be first overhauled and put in thorough working order before sale and will be open for inspection (and test, wherever possible) by appointment at Sukkur.

Service will also be given after sale and purchasers' men will be trained by arrangements, as long as the Barrage Construction Works and Shops are in existence.

A. A. MUSTO,
C.I.E., M.I.C.E., I.S.E.,
Superintending Engineer, Lloyd Barrage Circle.
Postal Address: Cables:
Sukkur, Sind, India. "SUKBAR, SUKKUR."

LIST OF PLANT & MACHINERY.

RAILWAYS.

About 40 miles of 5ft. 6in. gauge Railway complete and 9 Steam Locomotives and about 700 Wagons of all types, including 20-Ton Either-side Tipping Wagons. About 25 miles 2ft. gauge Railway complete and 15 Kerosine and 2 Steam Locos. and about 1100 Either-side Steel Tip Wagons of 27 cubic feet capacity.

FLEET.

Two Shallow-draught Suction Dredgers, by Lobnitz, 20in. discharge, to dredge to 30ft. each, complete with 1000ft. Floating Pipe Line and Terminal Pontoon with 150ft. overhang at 40ft. above water line.

Also Shallow-draught Paddle and Twin-screw Tugs, Motor Launches, Steel Barges, Pontoons, &c.

NOTE.—All motors on electrically driven plant are for A.C., 400 volts, 3-phase, 50 periods.

CRANES.

25-Ton and 10-Ton Electric Floating Derrick Cranes, 10-Ton and 1½-Ton Electric Derrick Cranes, 20-Ton and 2-Ton Steam Derrick Cranes. Also 5-Ton Steam Loco. Cranes and 10-Ton Electric Loco. Cranes, 5ft. 6in. gauge. Also 15-Ton, 12-Ton and 5-Ton Electric Goliath Cranes, 15-Ton Electric Shop Gantry Crane, and 15-Ton Hand-operated All-round Derrick Cranes.

PUMPS.

Sets of 8in., 4in., 3in., and 2in. Direct-coupled Electric Centrifugal Pumps for 40ft. head.

PILE DRIVERS.

Floating and Land Sets with McKiernan-Terry Double-acting Piling Hammers, Spencer-Hopwood Boilers, Zenith Winches and Steel Frames and Leads for driving 45ft. Piling.

STONE CRUSHERS.

"Acme" Jaw Crushers, 24in. by 15in., with Elevators, Hoppers and Screens and Portable Crusher, 12in. by 6in.

CONCRETE MIXERS.

Complete Plants for Moulding 10-Ton Blocks with Travelling Mixer Bridge carrying 2-Yard Ransome Mixers complete with Bunkers, Elevators and Batch Measuring Hoppers for materials, all electric driven. Also Steel Moulds for 10-Ton and 1½-Ton Blocks. Also Electric-driven Portable Mixers of sizes.

AIR COMPRESSORS.

Direct-coupled Electric-driven Sentinel Two-stage Compressors of 300 cubic feet capacity. Belt Drive Ditto of 550, 300, 188, and 140 cubic feet capacity respectively. Pneumatic Tools of all kinds.

DIVING GEAR AND DRESSES, &c.

ELECTRIC POWER PLANT.

Following Diesel Engines direct coupled to Alternators generating A.C., 6600 volts, 3-phase, 50 periods:—

2 Swiss Loco. 4-Cylinder Single-acting Diesels, 750 B.H.P., with Fly-wheel Alternator, 500 kW., by Oerlikon.

Metro-Vickers Cubicle Type Switchboard.

Johnson and Phillips Transformers, 6600 to 400 volts, of sizes.

H.T. and L.T. Overhead Transmission Poles, Cables, &c.

MORTAR MILLS.

Both Over-driven and Under-driven Type Mortar Mills, 8ft. dia. pans, with belt drive from countershaft.

WORKSHOP MACHINERY.

Lathes, Shapers, Planers, Milling Machines, Drilling Machines, Belt Air Hammers, Belt Hammers, Punching and Shearing Machines, Forges, Woodworking Machinery, Plate Rolls, Iron and Brass-foundry Equipment, Saw Sharpening Machines, &c.

QUARRY PLANT.

Compressed Air Drills of all sizes, Forging Machines, Oil Furnaces, Air Compressors, Oil Engines, Wire Saws, Channellers, &c.

STONE DRESSING PLANT.

Diamond Saws, Planers, Frame Saws, Rip Saws, Countershafts, &c.

ENGINES.

Oil Engines of various sizes.

BUILDINGS.

Steel-framed Stone Dressing Shop, 360ft. by 115ft., with 15-Ton Gantry Runway and numerous Smaller Steel Roof Trusses, &c.

STEEL SHEET PILING.

About 11,000 Tons "Universal" 15in. by 5in. by 43 lb. per square foot Interlocking S.S. Piling in 40ft., 45ft., and 50ft. lengths.

MISCELLANEOUS PLANT.

Such as Steel Riveted and Sectional Tanks of all sizes, with and without Staging, Winches, Jacks, Pulleys, Wire Ropes, Motor Lorries, and many other items.

A. A. MUSTO,
S.E.L.B.C.

MS.12/10. P.B. 40/30. 6445

PUBLIC NOTICES.

Borough of Bangor (County DOWN).

EXTENSION OF THE OLD PIER, BANGOR HARBOUR.

The Council of the Borough of Bangor are prepared to receive TENDERS for the EXTENSION of the OLD PIER. The work consists of the Removal of the existing Timber Pier Head and the Construction of about 100ft. of Concrete Pier and other work in connection with same, all in accordance with plans and specification prepared by the Consulting Engineer, Sir Cyril Kirkpatrick, M. Inst. C.E., 25, Victoria-street, Westminster, London, S.W. 1.

Copies of the instructions to persons tendering, deed of contract, general conditions, specification, bill of quantities and form of Tender may be obtained from the offices of the Consulting Engineer upon payment of £5 (by cheque only), which will be returned upon receipt of a bona fide Tender.

Drawings may be seen at the office of the Consulting Engineer or at the office of the Borough Surveyor, Town Hall, Bangor, Co. Down.

The carrying out of the works will be subject to conditions with regard to recruitment of labour and the use of British materials laid down by the Government of Northern Ireland and by the Borough Council.

Sealed Tenders, endorsed "Bangor Harbour," addressed to the undersigned at his office at Bangor, must be received before Twelve Noon on Wednesday, the 30th day of September, 1931.

The Council does not bind itself to accept the lowest or any Tender.

By Order,
J. MILLIKEN,
Town Clerk.

Town Hall, Bangor, Co. Down,
29th August, 1931 7468

Borough of Chepping Wycombe

WATERWORKS.

15IN. DIA. STEEL PUMPING MAINS.

CONTRACT NO. 1, STEEL PIPES.

The Corporation of the above Borough invite TENDERS from experienced British Manufacturers for the SUPPLY and DELIVERY at High Wycombe and West Wycombe Railway Stations of about 9400 YARDS of 15in. dia. SOLID-DRAWN WELDLESS STEEL PIPES, coated and wrapped, together with the necessary SPECIAL PIPES and BENDS.

Copies of the specification, bills of quantities and form of Tender may be obtained from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, upon depositing the sum of Five Pounds, which will be returned on receipt of a bona fide Tender.

The manufacturers will be required to observe the conditions relating to the employment of labour imposed by the Unemployment Grants Committee and to undertake to commence the manufacture of the pipes immediately.

Sealed Tenders, marked "15in. Dia. Pumping Main, Contract No. 1, Tenders for Steel Pipes," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 21st, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

P. B. BEECROFT,
Town Clerk.

Town Clerk's Office,
High Wycombe. 7470

City of Nottingham.

WESTERN BOULEVARD—SECTION NO. 3. BRIDGE OVER THE L.M. AND S. RAILWAY. RADFORD AND TROWELL BRANCH, AT RADFORD WOODHOUSE.

The Works and Ways Committee is prepared to receive TENDERS for the above, divided into two separate contracts as follows:—

CONTRACT NO. 1.—TO GENERAL CONTRACTORS. Consisting of Concrete and Brick Abutments, Wing Walls, Brick Jack Arches, &c.

CONTRACT NO. 2.—TO STRUCTURAL ENGINEERS. About 130 Tons of Steel Work in Eleven Plate Girders, 60ft. long by 4ft. 6in. deep, with Intermediate Diaphragms, &c.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained on and after Monday, 7th September, on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of £2 for each contract, which will be returned on receipt of a bona fide Tender.

Sealed Tenders are to be delivered to the undersigned in the official envelope provided not later than 6 p.m. on Thursday, 24th September, 1931.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform with the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
2nd September, 1931. 7471*

H.E.H. The Nizam's State RAILWAY.

REQUIRED for service on the above Railway, AN ELECTRICAL ENGINEER, who should have had proper technical training and should preferably be an Associate Member of the Institution of Electrical Engineers. Candidates must be thoroughly conversant with the installation and maintenance of industrial motors and switchgear, with a sound knowledge of train lighting equipment. Age not more than 30 years.

SALARY.—In the scale of Osmania Sicca Rupees 450-50-1000, but the commencing salary will be decided according to the age and qualifications of the candidate selected. The Osmania Sicca Rupee is the currency of the Hyderabad State and approximately O.S. Rs. 116 are equivalent to Government of India Rupees 100.

TERMS.—A three years' engagement in the first instance, first class free passage to India, and a return passage (if a European is appointed) on satisfactory termination of service. The selected candidate will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full details of applicants' age, general and technical education, practical training and subsequent experience, should be addressed to the undersigned not later than 18th September, 1931.

F. ADAMS,
Secretary,
H.E.H. the Nizam's State Railway Board.
269, Winchester House,
Old Broad-street, London, E.C. 2. 7475

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

WANTED, a NUMBER of RATE FIXERS, for an Engineering Establishment in Broadheath. Fitting experience a recommendation.—Address, stating age, qualifications and salary required, P1456, The Engineer Office. P1456 A

WANTED, to Take Complete Charge of Manufacture of Electric Arc Welding Plant, Electrodes and General Arc Welding Business, MAN with Electrical, Metallurgical, and Practical Welding knowledge, able to estimate on arc welding contracts and supervise design of arc welded products. Consideration will only be given to applicants having held a similar position.—Address, giving details of experience and salary required, 7463, The Engineer Office. 7463 A

WANTED, ENGINEER, Preferably with Experience in Refrigeration, to look after Electrical and Mechanical Plant in Food Packing Works (Lancashire).—Address, stating age, qualifications and experience, also salary, P1443, The Engineer Office. P1443 A

SITUATIONS OPEN (continued)

WANTED, for Large Textile Machinery Works, a thoroughly competent and widely experienced MAINTENANCE MANAGER, to Supervise Large Tool and Millwright Departments, and all Maintenance and General Engineering Work throughout the Works.

A practical, varied and intimate knowledge of Machine Tools and Tool Design is essential, together with the ability to get work through quickly.

A knowledge of Electrical Plant is desirable, but not essential.

Applicants should give full details relating to education and all positions held in the past, together with age and salary required.

Address, 7484, The Engineer Office. 7484 A

ELECTRIC LIFT MANUFACTURERS REQUIRE ORGANISER and SALES MANAGER. Personal London connection and able train and obtain best results selling staff. Must have first-class lift experience. State age, experience, salary, &c.—Address, 7481, The Engineer Office. 7481 A

ENGINEER REQUIRED as Assistant on the Tutorial Staff. Marine or Mechanical Engineering qualification necessary. Whole-time appointment.—Apply, stating qualifications, experience, age and salary desired, to the GOVERNORS, The Bennett College, Sheffield. P1455 A

ENGINEER SALESMAN REQUIRED for India, unmarried. Experience of Heavy Oil Engines, Centrifugal Pumps, and knowledge of country desirable. Good school and technical education necessary. Salary according to qualifications.—Address, with particulars of experience, copies of testimonials, 7474, The Engineer Office. 7474 A

FIRM of CONSTRUCTIONAL ENGINEERS in the North-East of England DESIRES to EMPLOY JUNIOR ELECTRICAL DRAUGHTSMEN or ENGINEERS to assist in the preparation and lay-out of Electrification of Iron and Steel Works.—Address, 7449, The Engineer Office. 7449 A

I AM SEEKING the ASSISTANCE of an ENGINEER with Executive and Sales Experience to Introduce a Line of Diesel Engines. Applicants must have initiative, enterprise and first-class record.—When writing, state full details of past experience, wages earned, and how soon free to commence duties, to: J. W. SHILLAN, 24, Harrison-street, London, W.C. 1. P1465 A

MANAGER WANTED. Capable and Energetic, for old-established Marine Repair Business in South Africa.

The works are modern and include departments for Hull Repairing, Boilermaking, Engineers, Pattern-makers, Iron and Brassfoundries, Coppersmiths and Plumbers, Electric and Acetylene Welding, Blacksmiths, &c.

The man appointed must be thoroughly experienced in all kinds of repairs to ships and ship machinery. He must be a good organiser, should possess good general knowledge, and have practical theoretical and commercial experience. He would usually require to tender for the work secured, and must be of strong character, accepting full responsibility, and determined to see the jobs right through in contract time.

A person who would take a financial interest in the business would be preferred, but it will be understood that to be an efficient manager is the first requirement, and if the applicant has any influence with shipping people this should be stated.

The salary proposed is £1000 per annum, or salary plus a percentage of net profits as might be arranged.

Apply (in confidence), stating age, experience, &c., with two copies of testimonials, to "3130," Wm. Porteous and Co., Glasgow. P1452 A

ASSISTANT MANAGER or GENERAL FOREMAN WANTED for the above works, young, ambitious and hard-working. Must be capable of assuming control during the temporary absence of the manager, and to the right man excellent prospects are held out.

Apply, stating age, experience, and salary required, to "WORKS," Wm. Porteous and Co., Advertising Agents, Glasgow. P1453 A

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REQUIRED for Resident Engineer's Staff in East Africa on Construction of Large Bridge, STEEL WORK INSPECTOR, with previous experience as Foreman in the Assembly and Erection of Steel Work of important Bridges.

BRIDGE FOUNDATION and CONCRETE INSPECTOR, with previous experience as Foreman in the Construction of Foundations and Piers of important Bridges and of Driving Concrete Piles.

Age 40-45, strictly temperate; salary £40 per month with free quarters and passage out and home.

Reply, stating age, if single or married, and giving full details of experience, &c., to Box "S.E.," c/o Davies and Co., 95, Bishopsgate, E.C. 2, London. 7480 A

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Must have had considerable experience in the Manufacture of A.C. and D.C. Motors and Control Gear, and have held similar position with good firm in the same line of business for at least five years.

Good disciplinarian and for one who is capable of bringing ideas forward, this is an excellent opportunity.

Write, giving qualifications and salary required, 7458, The Engineer Office. 7458 A

WATERWORKS FOREMAN.

DISTRIBUTION FOREMAN REQUIRED for Rural Waterworks; must be competent Plumber with experience of Main and Service Laying. Wages £3 13s. per week and house.

Applications only on form obtainable from the WEST GLOUCESTERSHIRE WATER COMPANY, Kingswood, Bristol, to be submitted by September 19th, 1931. P1447 A

SITUATIONS WANTED.

A YOUNG MECHANICAL ENGINEER (27), unmarried, B.Sc., three years' apprenticeship, experience of locomotives, building, repairing and drawing-office, last two years in Brazil, first-class references, SEEKS APPOINTMENT with prospects, abroad or at home.—Address, P1442, The Engineer Office P1442 B

AN ENGINEER, Age 30, with 5 Years' experience overseas with a mining and oil company, and a Degree, SEEKS an ENGAGEMENT. Overseas preferred; Spanish and Hindustani spoken.
Address, P1470, The Engineer Office. P1470 B

DIESEL ENGINEER, 28, B.O.T. Certif., SEEKS RESPONSIBLE SHORE POST. Varied steam and electrical experience, I.C.S. student, disengaged October; would consider Colonies if inducement offers; preference Canada.—Address, P1427, The Engineer Office. P1427 B

ENGINEER, with Good Practical, Sales, Commercial and managerial experience, DESIRES APPOINTMENT. Would be prepared to put up a certain amount of money for suitable opening. Public school, with works and university training.—Address, 7486, The Engineer Office. 7486 B

SITUATIONS WANTED (continued)

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ENGINEER (30), 3 Yrs. Univ., 4 Yrs. Shops, 4 yrs. mech., D.O., 4 yrs. aero. D.O. and stressing, DESIRES POST as Assistant to Works Manager.—Address, P1468, The Engineer Office. P1468 B

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ENGINEER, 36, with Extensive Experience of modern production methods, both mass and batch, principally small accurate mechanisms, DESIRES SITUATION as Works Manager or Works Superintendent. Managerial experience, good organiser; moderate salary.—Address, P1430, The Engineer Office. P1430 B

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REQUIRED, POSITION of TRUST; 27 Years' technical experience in iron and steel and non-ferrous metal works and laboratories, mechanical, constructional, chemical and metallurgical engineering, treatment of ores, pyrites, residues, separation, roasting, lixiviation, smelting, refining, blast, open-hearth, heating, retorts, and volatilisation furnaces, gas, oil and coal fuels, fume precipitation (wet, dry and electric), research, process development, design, planning, estimating, labour control and management. Testimonials best.—Address, P1459, The Engineer Office. P1459 B

DRAUGHTSMAN (21), Lifting and Shifting, also general patent office exp., Sec. Schl., London Schools Cert., Nat. Cert. Mech. Eng. and 2 E.M.E.U. Certs. Studying A.M.I.M.E. Refs. Low sal.—HAYWARD, 77, Marquess-road, N. 1. P1450 B

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FOREMAN SMITH SEEKS POSITION, Experienced smithing, forging, drop stamping, machine forging, heat treatment; technically trained.—H., 62, Norwich-road, Ipswich. P1461 B

FOUNDRY FOREMAN, Disengaged, SEEKS POSITION; 30 years' experience iron, steel, non-ferrous, hydraulic, marine, general; die castings, m/c latest methods of production, estimating and fixing prices; control with efficiency.—Address, P1469, The Engineer Office. P1469 B

FOUNDRY FOREMAN, 42, SEEKS CHANGE. At present with engineering works, Yorkshire, would suit a firm having trouble. Experienced in loam, dry, and green sand up to 20 tons; highest refs., low salary, expert on reducing costs.—Address, P1464, The Engineer Office. P1464 B

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For continuation of Small Advertisements see page 4.

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The Illumination Congress.

THE International Illumination Congress, which began in London on Tuesday, September 1st, has aroused widespread interest by reason of the flood-lighting of important buildings in London and elsewhere. A concerted effort has been made by the whole of the British lighting industry to make London attractive to foreign and other visitors. In Edinburgh, Glasgow, and other cities similar displays are being made, and it is hoped that the effect of these flood-lighting schemes will be to stimulate general interest in illumination. Many firms have been engaged in the work involved and much technical skill has been brought to bear on the design and arrangement of the electric and gas lighting equipments. Although it was originally intended that the London displays should last a week, the period has been extended to a month, so that ample opportunity will be given to the public to see and study these flood-lighting demonstrations. Of the London buildings that are being illuminated, Buckingham Palace is one of the most important and attractive. No fewer than 200 long-range G.E.C. projectors, equipped with the most powerful lamps, have been installed inside the courtyard around the railings of the Palace, and throw a light of 62 million beam candles on the building. The Victoria Memorial in front of the Palace is illuminated in amber by wide and narrow-angle beam projectors, with the result that the Memorial stands silhouetted against the brightened front of the Palace, as viewed from the Mall. The Institution of Electrical Engineers is flooded on similar lines, and among other important buildings being dealt with are the National Gallery and Nelson's Column, Thames House, Millbank, and the Carreras "Black Cat" cigarette factory. For the Buckingham Palace, Thames House and Carreras factory schemes the General Electric Company supplied the lighting and switching equipments, whilst Troughton and Young, of Knightsbridge, were responsible for the installation work. For the illumination of the Clock Tower of the Houses of Parliament, Holophane, Ltd., Siemens and Supplies, Ltd., and T. Clarke and Co., Ltd., were responsible. The Tower of London has been dealt with by the Benjamin Electric Company, Ltd., and Anderson Angell and Co., Ltd. Other well-known firms specialising in electric and gas lighting have taken part in the general scheme. It must suffice to say, however, that certain parts of St. James's Park, such as flower beds, trees, lawns, and the lake, are illuminated by a large number of specially designed gas lamps and projectors. The lamps were supplied by Foster and Pullen, whilst the projectors were designed by the technical staff of the Gas Light and Coke Company and made by William Sugg and Co., Ltd. Altogether the demonstrations reflect great credit on the British lighting industry, and it is to be hoped that the enterprising people who are responsible for these temporary equipments will find their reward.

Ultra Short Wave Broadcasting.

WITH a view to testing the claims made for ultra-short wave broadcasting, the B.B.C. has decided to carry out experiments in this connection, and an order is said to have been placed for a transmitter for broadcasting on waves between six and eight metres. The tests are expected to begin in about three months' time, and will probably coincide with those of the Telefunken Company in Germany. The system is known to offer certain definite advantages over the ordinary system, but it also presents disadvantages, and it remains to be seen whether it is really desirable from the point of view of listeners. In any case the B.B.C. explains that there is no chance whatever of the present regional system being scrapped and of existing receiving sets thus becoming useless. The main advantage of the ultra-short wave system is that to a large extent it overcomes the trouble of interference, but its range is strictly limited and the waves are not reflected back to the earth by collision with the Heavyside layer in the upper atmosphere. The ultra short wave transmitter which the B.B.C. directors have ordered will have a power of 1 kW, whereas that of the new regional stations have a capacity of 75 kW. If anything comes of the experiments, it will probably be the installation of ultra short wave auxiliaries for use only in an emergency.

Liverpool's Shipping Week.

ON Saturday, August 29th, Sir Percy Bates, the chairman of the Cunard Steamship Company, Ltd., formally opened the Nautical Exhibition at St. George's Hall, Liverpool, which forms an important item in Liverpool's Shipping Week. Sir Percy called attention to the fact that the main business of Merseyside towns was the forwarding of other people's trade. Each year, he said, there passed through the port something like £230,000,000 worth of British exports and 25 per cent. of all foreign arrivals and departures of passengers and imports. Some change had taken place since the Liverpool passenger developments of the nineteenth century had been diverted to the South of England, but there was always plenty of trade for Liverpool and the Merseyside if those engaged in the shipping industry in that area were willing to meet other people's transportation requirements. Times were difficult, it was admitted, but the economies which had been introduced in Liverpool had gone perhaps further than the port itself and would be followed elsewhere. Commenting on the display of ships ranging from a primitive float up to the latest liner, which has been organised by Commander Crane, R.N., Sir Percy said that the fine range of exhibits illustrated the fact that each successive type met the needs of its times. "To serve our day and prove worthy was the great duty laid upon us all." An opinion has been expressed in the district that an effort should be made to form the exhibits of ship models and modern navigating appliances into a permanent collection, illustrating the art of navigation and the history of naval and mercantile shipping which would be worthy of the port of Liverpool.

Railway Winter Timings.

UP till April of this year the fastest "start-to-stop" express in the world was the "Cheltenham Flyer" of the Great Western Railway, which was timed to cover the distance between Swindon and Paddington, a distance of 77¼ miles, in 70 minutes, giving an average speed of 66·2 m.p.h. In April, however, the "Royal York" express of the Canadian Pacific Railway was booked to travel the 124 miles between Montreal West and Smith's Falls in 108 minutes, giving an average speed of 68·9 m.p.h. That express has held the record since that time, but according to the winter timings of the Great Western Railway the record will again be secured by this country from September 17th, when the "Cheltenham Flyer" will travel from Swindon to Paddington in 67 minutes at an average speed of 69·18 m.p.h. The history of the timing of this train shows a continuous improvement. Before the war it ran non-stop from Kemble to Paddington, covering 91 miles in 103 minutes. With the return of normal services after the war it was given a stop at Swindon and ran thence to Paddington in 85 minutes. In 1923 the time allowed was reduced to 75 minutes, and a further reduction was made to 70 minutes in 1929. The fastest passenger night service train in this country will also run on the Great Western Railway when the winter train services come into operation. The 1.40 a.m. West of England express out of Paddington is booked to reach Plymouth, 225¾ miles away, in 265 minutes, at an average speed of 51·1 m.p.h. The other companies' time-tables also show considerable accelerations.

Tests of Explosives on H.M.S. Marlborough.

THE battleship "Marlborough," which has been condemned to be scrapped under the terms of the London Naval Treaty, has been used during the past two months for a series of tests as to the effects of explosions, such as those which occurred on a number of ships during the war, on warships. All the trials have been carried out in the Plymouth Sound. Last Friday a fourth test was made, like the first three in the forward part of the ship, the amount of explosive used, however, being considerably larger. The explosion took place at about 8.40 a.m., and the report was heard for many miles around, while the flash was also visible. As soon as the smoke had cleared away an examination of the extent of the damage was made, and a large hole was found to have been torn in the hull below the water line on the starboard side. Several compartments in the fore part of the ship were flooded. A number of Government tugs immediately proceeded to the spot in case any possibility might exist that the ship was in danger. In the evening the "Marlborough" was towed up the Hamoaze and docked in the North Lock at the North Yard, so that a more detailed examination of the extent of the damage could be made. The "Marlborough" is a battleship of the "Iron Duke" class, having a normal displacement of 25,000 tons. She took part in the Battle of Jutland, where she was torpedoed, but was able to continue fighting and to return home under her own steam.

Automatic Train Control.

ON Wednesday, September 2nd, when the last six ramps were fitted on the Weston-super-Mare loop lines, the whole of the Great Western Railway main lines between Paddington and Wolverhampton, Swansea, and Plymouth were brought under a system of automatic train control. In this system audible signals are given to the driver in his cab as to the state of the signals which he is passing. A shoe beneath the locomotive comes into contact with a ramp laid between the rails, which is electrically "dead" when the signal is at danger and "live" when the signal is at "all clear." The shoe beneath the locomotive is lifted by the ramp and if the signal is at danger operates the brakes and sounds a siren in the driver's cab. When the signal is "off," however, the ramp is energised and the electric current passes and prevents the operation of the brake, at the same time ringing an electric bell. The system is invaluable at night or in conditions of poor visibility. It was first tried experimentally on the Henley branch line and was later extended between Paddington and Reading. In 1929 the lines to Swindon, Oxford and High Wycombe were fitted with ramps, and in March last year it was decided to apply the system to a further 1758 miles of track. With the completion of the work at Weston-super-Mare 2130 miles of track and 2500 engines have been equipped to work on the system, the total cost of the installation being £250,000. It is believed that more punctual working of the trains will result from the improvement, and that it will help the working of the company's accelerated goods train services besides ensuring a greater degree of safety at all times.

Shipbuilding and Steel Prices.

SOME unofficial details are now available with regard to a scheme to ensure that British steel shall be used for ships built in the yards of the shipbuilders belonging to the Shipbuilding Employers' Federation. For some time negotiations have been taking place between that body and the Steel Makers' Association with a view to evolving some scheme whereby the present difference in price of nearly £2 per ton between British plates and sections and material imported from the Continent can be overcome. It is not possible for British steel makers to reduce their prices to meet this difference, but an arrangement has been proposed by them and now awaits official ratification by both parties. Briefly, the idea is that the steel makers make a levy on themselves or on the amount of steel produced in the country, which is calculated to raise £50,000. That sum would be raised over the ensuing six months by a levy from the producers in proportion to their make of steel, and would be placed to the credit of the shipbuilders as a subsidy to assist them in competing for orders which might otherwise go abroad owing to lower prices quoted by foreign shipbuilders. The sum would be handed over to the Shipbuilding Employers' Federation to administer and to disburse as might be required for such a purpose as we have outlined, on the understanding that shipbuilders would continue to use only British steel under the existing rebate system. Certain small details have yet to be worked out, but it is understood that some such arrangement, combined with the future cuts in wages, has been taken into account in preparing recent tenders from which several orders on the Clyde and North-East Coast for cargo ships have resulted.

The British Industries Fair.

ALREADY a very considerable amount of space has been booked for the Birmingham section of the British Industries Fair next year. At the beginning of August, owing to holidays, there was the lull in the rate of booking which is usually experienced at that time. During the following weeks the lull continued, and at the height of the economy crisis a few firms even withdrew the applications they had already made for space. Last week, however, there was a recovery, and the space booked was as much as 10,000 square feet. This is one of the best week's bookings ever recorded. It is stated that although most of the firms taking space have been regular exhibitors for a number of years past, many others which have not recently participated in the exhibition have booked space for next year's Fair. To date, 200,000 square feet have been definitely booked, leaving 40,000 square feet not yet taken up. The announcement was made some time ago that a cycle and motor-cycle section of the Fair would be formed at Birmingham, so that the range of exhibits will be even more extensive in future years.

The Schneider Trophy Race.

ALTHOUGH it was announced last Saturday, August 29th, that official notification had been received from the French Government that the French Schneider Trophy team would take part in the race and would bring three racing seaplanes, no confirmation of the report is yet forthcoming. Nor is anything yet known definitely as to the intentions of the Italian team. It is believed, however, that both nations will find themselves able to compete, although very much depends on the results of the tests now being made of the units built for the race. The French will probably enter two Bernard machines, and a Nieuport, but apparently trouble has been experienced in finding propellers sufficiently strong to stand up to the demands of the engines of the first-named machines. For some days conditions at Calshot during the last week were too bad to allow any practice flights to be made in the high-speed machines, but last Monday flying was resumed. Two of the practice machines discovered while in the air that a number of kites were being flown in the vicinity of the course and had to turn to avoid them. Since these high-speed machines might have considerable difficulty in seeing and avoiding them and since, if a collision occurred, the results might be serious, people in the area are to be acquainted by the police of the danger. Arrangements are now being made to deal with the large number of people who are likely to visit the district to witness the race, while work upon the erection of the pylons marking the turning points is nearly completed. • • • As this paragraph is going to press we learn that it is improbable that France and Italy will compete, but that the course will be flown by Great Britain alone.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. IV.—BENDING TOOLS (*continued*).*

VI. COMPOUND ACTION BENDING (v.).

IN the four accompanying illustrations—Figs. 22 to 25—a different application of the "rocker" bending principle is developed. An I-shaped blank—shown at A in Fig. 23—has to be marked with a patent number along the main portion of its 2in. length and subsequently bent to the shape shown in the same photograph at A'.

The chief difficulty lay in the fact that plain "draw-bend" tools would necessitate auxiliary bending slides, and the primary draw would tend to obliterate the marked surface where the first pressure was applied. To overcome this, the draw bend

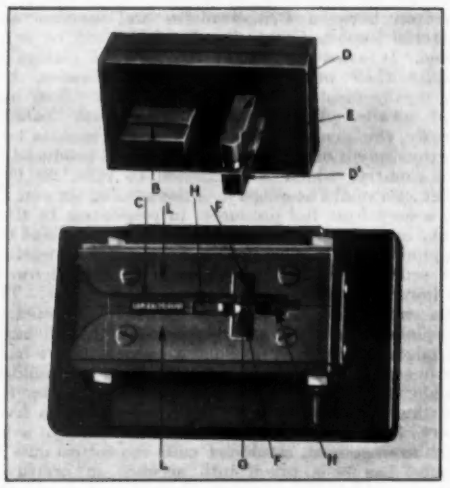


FIG. 22

principle was applied, but with the primary bending points of the die separated sufficiently to miss the marked surface of the blank. Auxiliary bending slides were dispensed with in the manner described below.

Fig. 22 shows a view of the die from above and a view of the punch from below. Fig. 23 shows the die with one side removed and a further view of the underside of the punch. Fig. 24 shows punch and sectional die while bending is in progress; and Fig. 25 shows the tools immediately before the final squeeze of the press.

As will be seen from the illustrations, most of the chief parts of the tools are duplicated. The main parts that are not so duplicated are indicated by the letters B, C, E, and G, of which B forms the anvil

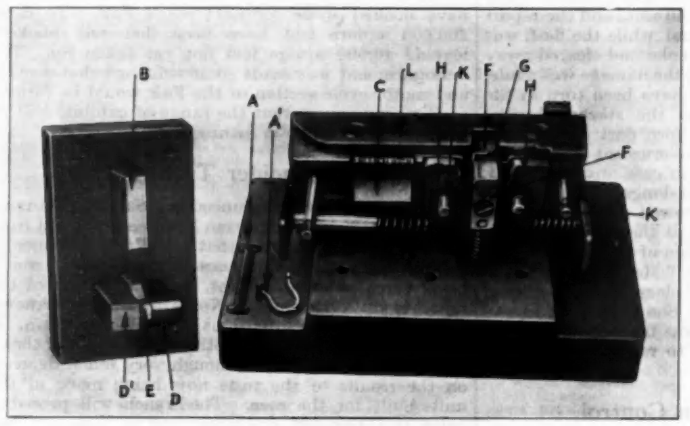


FIG. 23

and C the cut punch for the marking process. Apart from the fact that the length of B is regulated by the position of the tools in relation to the final bending squeeze, there is nothing to note particularly about this portion of the complete operation.

The top plates L of the die serve four separate purposes:—a track for the passage of the marked blank, side gauges for both processes, end gauge for the bending operation—the blank to be marked is end-gauged from the other end of the bending blank—and a stop for the rocker drive pad F, which is raised by springs let into the die shoe, one of which is visible in Fig. 23 only. The form punch and the rocker drive pad are each built up in three sections. The construction of the punch is to be clearly seen in Fig. 23, and the construction of the pad is shown by the same illustration in conjunction with Fig. 24. It was essential that no pressure should be exerted on the surface of the blank, and it was therefore necessary to transfer the punch pressure directly to the rocker drive pad without passing through the blank. Accordingly the actual form around which the blank is bent is shown at E in the engravings, and is made from ¼in. tool steel. It is supported on each side and screwed and dowelled to the two pressure-carrying punches, D and D'. Of these two punches the one to the front of the tools—D—had to be shaped to allow of easy removal of the bent blank from the form E, the one at the back being left full size. The pressure punches engage with the outer pieces of the pad F, which, in turn, transmit the pressure through dowels to the actual driving punch G for the rockers. This part G serves the dual purpose of rocker drive punch and locked pressure pad for the form punch and blank. As will be clearly seen in Figs. 23 and 24, a fixed minimum distance is preserved between punch and pad—an easy fit for the metal of the blank—and in action this minimum distance is preserved, since, if the blank tends to develop an extra and unrequired bend in the base, it has to force this pad downwards, and by so doing increase the bending movement of

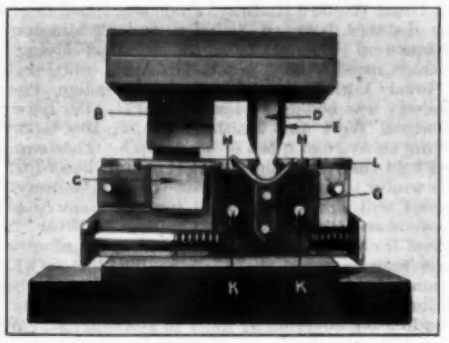


FIG. 24

the rockers H before this extra bend can become a fact. The bending rockers H are swung on the two pivot pins K, which are supported in each half of the main die block. Powerful balanced compression springs are fitted to keep the rockers in the fully "up" position until they are engaged by the drive G. The rockers have a positive lock to their movement in each direction, their outer edges coming into contact with the main die block in which they work. In both rockers the lower edge is in the form of a radius to allow free action above the die shoe, and in the case of the left-hand rocker—that nearest the marking punch—the outer top corner is also in the form of a radius to allow it to swing without coming into contact with the blank covering the marking punch which overlaps the edge of this rocker.

In action work can either be commenced by rough-gauging a blank for marking or two blanks can be placed in position, the one over the bending dies being removed before the stroke of the press. With one marked blank on the die a blank is slipped between the tapered ends of the gauges L and pushed forward so as to carry the marked blank over the bending dies, where both are stopped by the end gauge. All exposed edges on the die that tended to catch the blanks in their end-to-end progress were transformed to small angle faces and the feeding of the blanks can be as rapid as a simple single feed. The punch descends and catches the marked blank between the form punch E and the primary bending points of the rockers H, putting in the primary bend consisting of a right angle with substantially a radius in the corner. As soon as this bend is completed, the rockers, driven by the pad G—which derives its power from the punches D *vid* the pads F and dowels—swing their upper halves inwards to complete the bend as shown in Fig. 25. A final squeeze is given to the bend, and this portion of the press stroke also serves to mark the other blank in the tools ready for the next operation. The punch rises and carries with it the bent blank, which is easily removed by drawing to the front over the drive punch D. The complete drive pad F and G is lifted level with the die surface by spring pressure, and the rockers return to their original position also by spring pressure.

The rocker springs furnish a graphic illustration of my earlier arguments with regard to the "drawing" strain in plain V-shaped dies. Reference to Fig. 24 will show that in effect the first half of the bending operation is identical to that produced on V-shaped dies. The upper bending edges of the rockers, corresponding to the edges of a V die have an easy radius and a very high polish. Light springs were originally fitted to the rockers with the sole intention of returning them to the "up" position, but it was found that the bending blank drew the rockers inwards sufficiently to jam the tools in spite of the polished radii forming the bending edges. Eventually, it was found necessary to fit the springs shown, which are powerful enough—when compressed to the position in which they are shown in Fig. 24—to transmit a pressure sufficient to put in the primary bend of the blank without further compression of themselves.

Seeing that the bottom edge of the spring is approximately the same distance from the centre of the rocker pivot pin as is the radius bending point of the rocker, it seems reasonable to draw the conclusion that the pull or drawing stress exerted by V-shaped dies on a blank during a "draw-bend" operation is certainly not less than the pressure required for the actual bend,

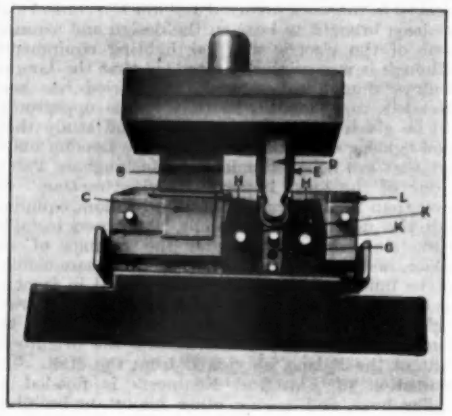


FIG. 25

and from this it can be seen that the metal is actually subjected to twice the stress imposed by a true bend. In worn, rusty, or badly polished "draw-bend" dies the proportional stress on the metal is obviously greatly increased, and this is also proved in the present tools, which tend to pull in the rockers and jam the tools with the present springs unless the high polish on the radii of the bending edges is preserved.

VII. COMPOUND ACTION BENDING (vi.).

The small bent pressing described in the preceding article is subsequently closed over a link of a chain, and for some time it was difficult to see how to bring the two T-shaped ends together in a manner that would prevent them from springing open slightly. It was found that pressure exerted on each side of the shape either allowed the ends to spring open, or if the radius bend was squeezed on its circumference,

FIG. 26

the extreme ends of the pressing were levered open by the reduction of the radius bend, while the outward bend of the arms remained the same. Experiment showed that if the two ends were first brought together and squeezed dead parallel, held tightly in that position, while a further squeezing pressure was applied to the half circle immediately opposite the arms, the two T-shaped arms would remain sprung together when all pressures were released. To obtain this result in press tools, a compound action was obviously necessary, and the tools illustrated in Figs. 26 to 28 were produced. The final operation is carried out on a half-round die shown at D, which is mounted between two mild steel plates C on the baseplate. This die is slightly thicker than the width of the bar of the bent pressing, and in common with the plates C has a slot at the base of the half-round shape to accommodate the chain link to which the pressing is attached. Two hinged punches are mounted on the pegs H in the punch pad. These punches G are of flat steel, the thickness of the width of the main bar of the pressing, and are consequently an easy fit between the plates C, which act as guides and supports

* No. III. appeared August 28th.

for these punches. Each punch is provided with a 45 deg. angle at the lower end of its outer edge, and this angle face engages on a roller revolving on the pin F hinging the punches inwards towards each other. The overall width of the two punches when closed is equal to the distance between the edges of the two rollers, and therefore the rollers force the two punches together, and afterwards allow them to continue downwards while at the same time holding them firmly together. When the punches are clear of the rollers they are forced apart by the spring K as far as the link L will allow in its elongated connecting holes. The points of the punches G are each fitted with two side plates M, screwed and dowelled together and providing a recess at the working point of the

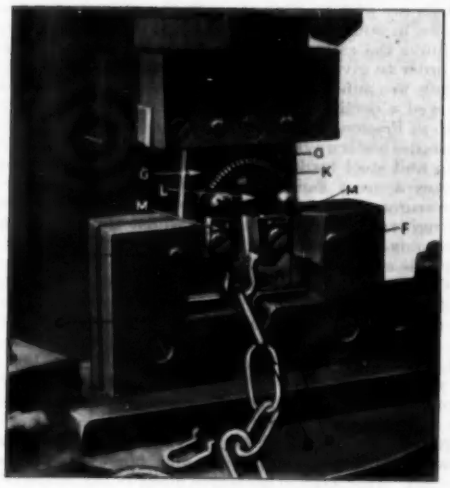


FIG. 27

punch to fit the T-shape of the arm of the pressing exactly.

In action, the bent pressing—as shown at A in Fig. 26—is threaded through the chain link B and inserted between the gripping points of the punches—as shown in Fig. 27. A slight drop of the press ram suffices to operate the gripping action, and the operator's hand is removed while the press stroke continues, bringing the two arms of the blank together, and holding them. The completed bend is then carried down into the die D for the final squeezing pressure to the lower semi-circle of the pressing—as shown in Fig. 28—and resulting in the pressing being tightly closed—as shown at A′ in Fig. 26.

Another application of the same principle of rocking

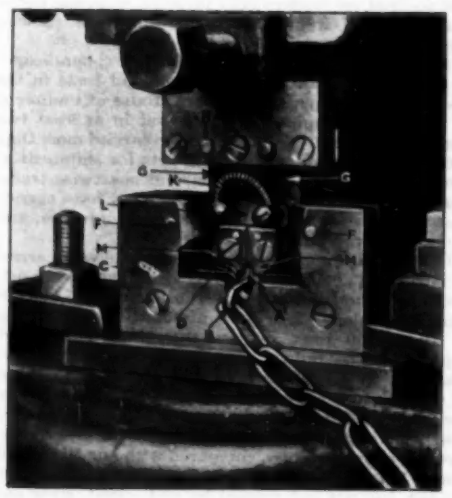


FIG. 28

punches is shown in the three engravings, Figs. 29 to 31. The spring, which formed the subject of the first set of compound action bending tools described in this series, has reached its final shape after a further three operations, and has to have a collar or strap—as shown at A in Fig. 30—curled on to its two arms, close to the eye B—as shown at A′. Originally, this was done in radius curling dies, but as the die that formed the actual curl had to support the sides of the pressing to be curled for not less than ¼in. past the centre of the curl, the opposite die, which merely acted as a base support for the pressing during the curling operation, and yet had to conform to shape of the blank, was of a broad and shallow U-shape section, with the blank-supporting radii terminating in knife edges. These edges were a constant source of trouble, and necessitated continual replacement of the supporting die on account of the regular chipping or burring of the edges. Dies without these radius supports would not produce a satisfactory finish, and if the edges were increased in thickness, the curling die had to be cut away to admit them, with the result that a large percentage of blanks collapsed at their sides during the curling operation. After the successful design for chain hook closing had been proved, the principle was immediately adapted to the spring collar strap assembly with complete success, giving a far stronger result in that the strap was wrapped around the wire tightly, whereas on the curling principle, the curl was of necessity a fairly easy fit on the wire.

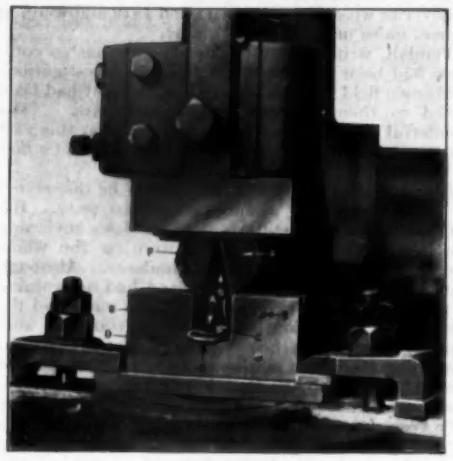


FIG. 29

For the sake of clearer presentation, the tools are shown in the engravings set back to front in the press. In normal use the main portion of the spring is to the front of the press, and the punch is offset to the front of the press ram to give room for the

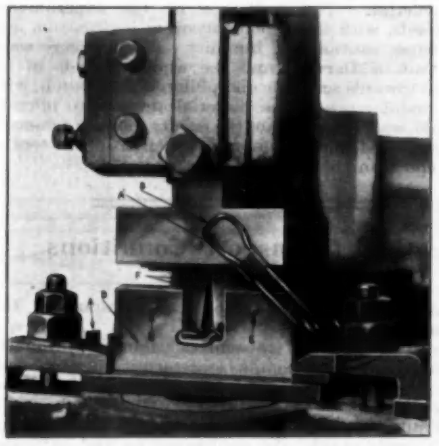


FIG. 30

ends of the spring, which are equal in length to the double-formed arm and are set at an angle of 45 deg. thereto.

The construction of the tools is mainly the same as before. The rocking punches F are hinged on pegs in the punch pad and are kept apart by the compression spring G, being stopped from opening too

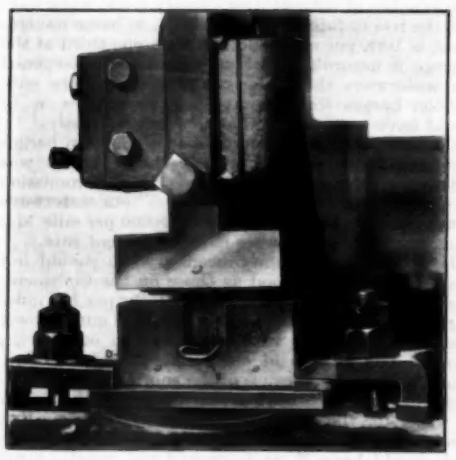


FIG. 31

wide by contact with the punch pad. The angle faces of the punches engage with rollers carried on the pegs E in the die carrier plates D. Of these two die carrier plates, the one to the actual front of the tools is extended upwards—as seen at C in Fig. 29—to come between the two wires of the spring, and give them the necessary support during the wrapping operation. No such support is required on the opposite plate, the wire itself being sufficiently strong to carry the pressure to the end of its bend.

The actual supporting die is provided with a U-shaped recess for the bent collar strap of a depth equal to the diameter of the finished curl. Unlike the previous tools, the two parts to be assembled are placed directly on this final die—as shown at A and B in Fig. 29. On the down stroke of the press the punches F engage with the two perpendicular arms of the collar strap, and bending them over against the resistance offered by the wire of the spring—as shown in Fig. 30—continue downwards close together and wrap the strap around the wire—as shown in Fig. 31. Any tendency for the two wires to spring inwards during the preliminary bending-over of the arms of the collar strap is corrected by the driving in of the two points of the punches, which, in their combined thickness, are equal to the wire support on the front carrier plate for the die, less a suitable allowance for the thickness of the metal in the curls of the collar strap.

(To be continued.)

Faraday and Modern Electrical Developments.

By COL. T. H. MINSHALL, D.S.O., M.I.E.E.

ON August 29th, 1831, Michael Faraday made the greatest of his many discoveries—the relation of magnetism to electricity and the principle of electro-magnetic induction.

Professor John Tyndall, writing in 1868 of Faraday's work, said: "The question may arise in some minds what is the use of it all? The answer is that if man's intellectual nature thirsts for knowledge, then knowledge is useful because it satisfies this thirst. . . . . Still, if needed, an answer of another kind might be given." And he proceeded to say that nearly the whole of medico-electric science, the development of the telegraph and of the electric lighthouse, *i.e.*, practically the whole of the comparatively meagre developments of electricity at that date, were mainly due to the discovery of electro-magnetic induction, and were thus almost directly traceable to Faraday's discoveries.

Faraday himself, writing in 1831, said: "I have rather been desirous of discovering new facts and new relations dependent on magneto-electric induction than of exalting the force of those already obtained, being assured that the latter would find their full development hereafter." This assurance has been so amply fulfilled that to-day it is difficult to mention any branch of electrical science or engineering which does not owe something, and in most cases a great deal, to that brilliant series of researches carried out at the Royal Institution for some forty years from 1820 onwards.

When considering what we owe to the discoveries of Michael Faraday it is not possible to draw a hard-and-fast line between the developments which followed from the fundamental principles he discovered, or which his discoveries led to, and those more directly due to the specific facts he established.

Modern scientific thought—directly—and modern engineering and applied science—indirectly—are deeply indebted to both of these branches of his work.

On the theoretical side the electro-magnetic theory of light, the study of the ether and kindred developments of scientific theory, right down to the quantum theory, trace their origin to, or have been deeply influenced by, his own experiments and writings on polarised light, diamagnetism, the magnetisation of light (1845), the study of crystals, &c. On the more purely utilitarian side, few, if any, of the more important practical developments in electrical science could have taken place until the "Identity of Electricities" (1833) had been established.

But some of his speculations were almost as remarkable as his actual discoveries. He sought, for instance—far in advance of contemporary thought—to free himself from the bondage of the atomic theory, and his views have had a definite influence on modern chemistry. Again, speaking of matter as made up of molecules separated from each other by space, he observes: "Space must be taken as the only continuous part of a body so constituted." And he says of his theory of "gravitating force" that this "notion so far as it is admitted will dispense with the ether." Some of the latest developments in the theory of the structure of the atom are prophetically foreshadowed in the following sentence at the end of his first series of papers on magne-crystallic action:—"I cannot conclude this series of researches without remarking how rapidly the knowledge of molecular forces grows upon us and how strikingly every investigation tends to develop more and more their importance. . . . . A few years ago magnetism was to us an occult power, affecting only a few bodies, now it is found to influence all bodies and to possess the most intimate relations with electricity, heat, chemical action, light, crystallisation and through it with the forces concerned in cohesion; and we may in the present state of things well feel urged to continue in our labours encouraged by the hope of bringing it into a bond of union with gravity itself." And this was written eighty-four years ago!

Considerations of space forbid more than a brief reference to the debt which electrical engineering

proper and the many allied developments of electrical science owe to the work done by him at the Royal Institution.

In considering these practical developments it will be remembered that the discovery of electro-magnetic induction was only one—and possibly not the most profound of the results obtained. Faraday's researches in electro-chemistry were almost the starting point of that science, while his experiments on specific inductive capacity produced vitally important knowledge for submarine cable design, and in the development of condensers such as are used in wireless apparatus and many other connections. His work on optics and terrestrial magnetism were of importance in astronomy and navigation.

But it is the discovery of electro-magnetic induction—usually considered the most important and certainly the most famous of his discoveries—that has led most directly to the majority of the practical applications now in everyday use.

In the year 1820 electrical knowledge was, speaking generally, confined to the phenomena of "galvanic" electricity, derived from the nerve tissues of certain animals, of frictional electricity obtained from different kinds of electrical machines and Leyden jars, and of "Voltaic" electricity obtained from "Voltaic piles" and simple batteries. Even the identity of these various electricities was not established until Faraday's paper on "The Identity of Electricities" in 1833.

A relation between electricity and magnetism had long been suspected and sought for. It was discovered between 1819–20 by Oersted, who, by observing the effect of the electric current upon a magnetic needle, established the existence of electro-magnetism. Four years later Sturgeon invented the electro-magnet, thereby proving that electricity could produce magnetism. The reversal of the process baffled the continued efforts of the best physicists—or "philosophers," as they were then known—including Ampère, Oersted, Arago and Foucault, and Faraday himself for over ten years. As early as 1822, when he discovered the rotation of wires carrying currents round magnets, he made a note "convert magnetism into electricity." But experiment after experiment is recorded in his notebook "No result." In 1824–1825, when his first paper on "Magneto-electric Induction" was read before the Royal Society, and especially in 1828, he was very near to making the discovery. He had his adjacent coils of wires, his bar magnet surrounded by wire and in fact all the necessary apparatus. His failure was due to the fact that he was looking for a static result, not a transient effect. But on August 29th, 1831, he made his fifth and successful attempt, though it is not quite clear how far the actual discovery of the hitherto missing detail in the experiments was accidental. The event was enshrined in a couplet in *Blackwood's* :—

> Around the magnet Faraday
> Is sure that Volta's lightning's play.
> But how to draw them from the wire ?
> He took a lesson from the heart
> 'Tis when we meet 'tis when we part,
> Breaks forth the electric fire.

His apparatus consisted of a soft iron ring wound with two independent coils of insulated wire. On connecting one coil to the battery he noticed a "kick" on the galvanometer in the other circuit.

Not only had Faraday discovered the method of producing electricity from magnetism, but the same experiment equally proved the induction of neighbouring circuits and incidentally employed the first transformer. On the third day of his subsequent experiments momentary currents were produced in coils moved past permanent magnets ; on the fourth day two coils were employed without an iron core and the principle of induced currents—not apparently fully appreciated during the first experiment—definitely proved. On the fifth day the permanent magnet, instead of the coil itself, was moved and current again produced and the problem of the conversion of magnetism into electricity definitely solved. On the ninth day, by revolving a copper disc between the poles of a permanent magnet, a steady current, instead of a transient one, was obtained and incidentally the first dynamo employed. In addition to describing the facts of his discovery, Faraday referred to and clearly laid down for the first time the law relating to the lines of magnetic force.

Thus in ten days of actual experimenting between August 29th and November 4th, 1831—though doubtless many other hours were spent in thinking over the problem—Faraday not only discovered electric induction, but invented the transformer and the dynamo and in addition laid down the relevant laws in one generalisation of the utmost simplicity which held good for at least fifty years.

This discovery was essential to the development of telegraphy and telephony and wireless for the transmission of signals, as well as to the dynamo, the electric motor, and the transformer employed in the transmission of power. It has also made possible the induction coil used in electro-therapy, as well as the transformer in wireless and the magneto in internal combustion engines used for land, sea and air transport. The list could be extended almost indefinitely to all modern applications of electricity.

The argument sometimes advanced that all such discoveries as those made by Faraday would sooner or later have been made by others is even more beside the point in his case than in that of most pioneers, whether in science or geography. Instances of almost simultaneous discoveries, such as have so often occurred in the history of astronomy, chemistry and geography, were almost absent in Faraday's career. And even in the case of specific inductive capacity, where he had been to some extent anticipated by Cavendish as long ago as 1773, the latter's discoveries were not published until 1879 and were, of course, quite unknown to Faraday.

Tyndall, writing in 1868, points out that so complete had been the scope of Faraday's investigations in his own field that nothing of real moment had been added to them for five and thirty years. "His wonderful mind overran in a single autumn this vast domain and hardly left behind him the shred of a fact to be gathered by his successors."

But it was not only the facts which he discovered by his experiments which were so accurate. His deductions, and the statement of the laws governing the facts which he laid down, were on the whole equally remarkable for their soundness. Although Faraday was no mathematician and had no training in philosophy proper, the clarity of his mind and the methods of expression he gave to his thoughts were such as to enable mathematicians at once to grasp his ideas, put them into mathematical form and proceed further to develop the theories consequent on them. The great mathematician, Clerk Maxwell, nearly fifty years later, said :—"After nearly half a century . . . . no exception to the statement of these laws (those referring to the lines of magnetic force) as given by Faraday, has been discovered, no new law has been added to them, and Faraday's original statement remains to this day the only one which asserts no more than can be verified by experiment, and the only one by which the theory of the phenomena can be expressed in a manner which is exactly and numerically accurate."

But the debt which the world owes to Faraday, and the admiration with which his memory is regarded, is only partially due to the importance of his actual discoveries. The brilliance of his experimental methods, with their combination of imagination and patience, caution and humility—akin in many ways to that of Darwin—and the whole attitude of his mind towards scientific and philosophic research, with his indifference to its material rewards to himself, would, apart from any of the results actually achieved, have placed him high among the great characters of his epoch and his country.

Coal Transport Conditions.

By E. T. GOOD.

CONDITIONS and costs of coal transport in this country constitute a "scandal" and a "handicap," according to a noted statesmen speaking in Parliament a short time ago. Similar statements are often made by various people, and canal transport is often advocated.

Transport is mainly an engineering problem, and as regards canals, the modernisation and extension of which is so loudly recommended, the main point in the problem is that of levels, and the second is that of water supply. We are often invited to make canals like those of foreign countries. We cannot make such canals, any more than, say, Switzerland can make seaports like ours. Taking the inland waterways of Germany, France, Belgium, Holland, Austria and Poland in the bulk, they traverse country so level that the average rise or fall is less than 1ft. per mile of navigation, and two-thirds of the navigation consists of natural river—ready-made waterway. But the rise or fall on British canals, in barge navigations, is 10ft. per mile, and less than one-third of the mileage is natural. If we so widened and deepened our waterways that they could accommodate only 100-ton barges throughout, at least 9 miles in 10 would have to be artificial and, therefore, costly.

German canals which accommodate 600-ton barges cost only £8000 per mile to construct ; but it was authoritatively estimated for our Royal Commission on Canals that merely to "improve" our waterways to take 100-ton boats would cost £28,000 per mile, and that was when wages were half the present rate.

If we spent the money necessary we should not have canals half so good as those on the Continent. We should have ten times as many locks per 100 miles of navigation, so that transport would be much slower and more expensive with us than with our foreign rivals. The upkeep of our canals would be correspondingly costly because of the enormous number of locks and lock gates. Then there would be the matter of water for the upper reaches or high levels. Few foreign canals are many feet above sea level. We have, and should have if we improved our canals, many miles more than 100ft. above sea level. It is only with difficulty now that we maintain a sufficiency of water in the upper reaches. If we widened and deepened the canals, made our locks bigger, and used them on a more extensive scale, the loss of water downward with every lockage, or every "pen" up and down, would be such that the problem of pumping enough water back to the top would be an extremely costly and difficult, if not an impossible, engineering proposition. Furthermore, our cities are taking more and more water from bigger and bigger catchment areas, and the day may not be far distant when the idea of using a lot of water for inland and high-level canals may have to be abandoned. Frost is another adverse factor which has to be considered. Our canals are often ice-bound in winter, as they are short of water in dry seasons. The canals of Germany, Belgium, Poland and Northern France were frozen up many weeks on end last winter. It took coal barges from November to the end of February to get from Nord collieries to Paris. German mines and ironworks and factories dependent on water transport were shut down for several weeks.

It is stated that canal transport is cheap. It is cheap only in very favourable circumstances and in a few selected areas. From Westphalia to the south-east of Germany, parts of the country being hilly, rail rates are lower than canal rates. In France the canals are able to compete with the railways for coal traffic in some areas only because the Government requires the railways to charge artificially high rates in order to give the canals a chance, and because the canals are subsidised. Nevertheless, the last Census showed a decline in the number of barges and bargemen in France, notwithstanding the acquisition of the Lorraine waterways and the great increase in the coal, iron and steel trades of the country. In the United States a great canal made and maintained by the Government at the public cost has failed to attract enough traffic to pay its way, whilst the railway in the same area has vastly increased its traffic and revenue and pays a big direct tax to the Government.

Canals in our own country cannot challenge the railways seriously even for coal traffic in comparatively flat parts, whilst in hilly districts canal transport is practically ruled out of competition. Of the 19,500,000 tons of coal and coke received by London in a year, canals carry less than 100,000 tons. That would not be so if canal transport was economical. In Yorkshire we have a striking object lesson. We have a barge canal, or inland navigation, 100 per cent. efficient, planned, equipped, and operated to perfection. This navigation serves many of the collieries ; it has an equipment of lifts, hoists, special high-capacity coal carriers, tugs, &c., which constitutes the latest word in canal engineering. The best designs abroad do not surpass, if they equal, those of the Aire and Calder Navigation in Yorkshire. The natural conditions are also far more favourable than those to be found in most other British industrial areas. The canal is served by and linked up with the rivers Aire, Calder, Don and Ouse. There is unusually level ground between Castleford and Goole, or it may be said between Barnsley, Leeds, Wakefield and other colliery districts and Goole, and all the way from Goole to Hull there is wide and deep tide water—the natural and ready-made channel of the Humber and the lower part of the Ouse. In spite of this extremely favourable combination of natural advantages, engineering skill and efficient management, and notwithstanding the fact that the rail rates on coal from the pits to Hull are higher than to other shipping ports, Hull receives twenty times more coal in railway wagons than in canal barges.

Turning to the alleged "scandal" or "handicap" of our railway transport conditions and costs in the case of coal, as mentioned in the House of Commons by Sir Herbert Samuel, we find that in at least two years—1913 and 1923—our railways carried more than 100,000,000 tons of coal to the ports for shipment as foreign cargoes, ships' bunkers and coastwise trade, plus the coal required in the ports. They have carried that tonnage without delay, without confusion, and with the minimum of breakage.

German railways have never yet in one year carried so much as 35,000,000 tons of coal for export to ports and land boundary stations. Adding about 5,000,000 tons for bunkers, their limit of capacity may be put at 40,000,000 tons, or less than half the British capacity. The railways of the United States have managed to carry down to the docks as much as 20,000,000 tons for export and about 10,000,000 tons for bunkers in one year. That is their limit. Last year they carried only 2,500,000 tons for direct shipment as export cargoes, compared with our 50,000,000 tons. Poland, our second or third biggest coal competitor, has not yet carried by rail, canal, river and road combined 15,000,000 tons of coal in a year for export, or as much as 10,000,000 tons to the docks for export. Our railways regularly and easily handle as much shipment coal as the railways of any four foreign countries put together ; yet a prominent British statesman describes British railways as "mere toys."

On the point of cost the average rail rates on our coal, pits to ports, are barely 2s. per ton. With all the dock charges added to the rail rates, the inclusive cost of carrying coal from pithead to ship's bunker averages only 2s. 6d. per ton in Britain. The bedrock-bottom foreign rail rate for shipment coal is the Polish subsidised rate. It is 3s. 4d. per ton, but the dock charges and demurrage terms are such that the actual pit to ship's hold cost is 5s. per ton, or 100 per cent. more than the corresponding cost in this country. In Germany the average rail rate on export coal—the average spread-over coal for the ports and for the land boundary stations—is 7s. 6d. per ton, plus the dock charges, &c. In the United States the average pit to port rail rate is 9s. per ton. Where, then, is the alleged "scandal" or "handicap" of coal transport conditions or costs ? And where is the foundation for the idea that we might have more economical coal transport if we used canals instead of railways ?

The Grampian Hydro-Electric Power Scheme.

No. V. (*conclusion*).*

GENERATING STATION (*continued*).

The turbines are directly coupled to vertical-spindle alternators arranged immediately above them. These alternators, which were made by the British Thomson-Houston Company, Ltd., and have their exciters coupled to extensions of their spindles, are of the self-cooled type, and have an output of 16,000 kW at 0·8 power factor. They are supported from Michell thrust bearings. The normal generated pressure is 11,000 volts, but the machines are designed to work satisfactorily over a wide range of voltage, and up to a maximum of 12,500 volts, so that, when working in conjunction with Tirrill booster regulators and dual exciters, quick voltage adjustments may be made. They will give their rated kVA down to a power factor of approximately 0·65 lagging, and they are also suitable for delivering 14,000 kVA at zero leading current. The voltage is capable of being reduced to a low value, so that the large charging current required for long transmission lines can be supplied.

The generators are of the duct-ventilated type, the quantity of ventilation air per machine being 39,000 cubic feet per minute, and its velocity through the floor ducts being 1000ft. per minute. They supply an 11,000-volt duplicate bus-bar switchboard, which is equipped throughout with motor-operated switchgear having a breaking capacity of three-quarters of a million kVA rating, and the switchgear and alternators have been fitted with the most modern forms of protective gear and switching arrangements.

The water used for cooling the bearings of the machines in the power-house and the transformers in the outdoor sub-station, to be described later, is raised from the tail-race by means of a small electrically-driven pump into a tank arranged on the roof of the power-house. The lavatory services in the latter are supplied with water from a pipe from the estate water service, which, as we said before, is derived from a branch of one of the breeches pipes in the valve house.

The low-tension auxiliary supply to the station, which is at 2200 volts, is obtained from a third winding on the step-up transformers, referred to hereafter, and in order that the advantages of a duplicate supply may be obtained without paralleling these transformers through the third or intermediate winding, automatic change-over switchgear is installed so as to ensure that, if either transformer is alive, a low-tension supply is available from that source.

Arrangements have also been made so that, should future requirements demand it, an alternator may be installed and coupled to an existing Pelton wheel, and a third supply will then be available. By means of this arrangement, the auxiliary supply would be obtained without the necessity of coupling small transformers to high breaking capacity switchgear.

Various exterior views of the power-house and its vicinity are given on page 246.

AUXILIARY ARRANGEMENTS IN THE POWER-HOUSE

The D.C. supply in the power-house is 110-volt current supplied by a 54-cell Chloride battery, which has a capacity of 250 ampère-hours. The battery is continually trickle-charged by means of a small rectifier and, in addition, a motor generator is provided so that it may be speedily charged up in the event of any abnormal service being demanded of it. This supply is a stand-by, and is used for oil switch tripping, and also for driving a motor generator in the reverse direction so that an A.C. supply may be given from the battery through the motor generator for pilot lighting in the power-house in the event of the main supply being off.

A tell-tale fault indicator which is arranged to give an indication of any faulty circuit is provided. A visible indication is given on the indicator, which is marked up with the name of the apparatus or machine to which the alarm refers. On the occurrence of any faulty conditions, this indicator is illuminated and an alarm is at the same time given by a bell. The indicator particularly refers to the temperature of the various plant in the station and in the outdoor sub-station, and to special relays which are concerned with the operation of the station.

The water levels at Loch Rannoch, Loch Ericht, the surge shaft and the tail-race are all indicated on the switchboard by a modified reading instrument, which gives the levels of the water at those places, and a record of the change in levels can also be obtained on a recording instrument, so that any surging in the water level which occurs—as, for example, in the surge shaft—can be indicated. The apparatus is of the simplest nature, and was provided by Messrs. Isenthal and Co. A high resistance rod is immersed in the water where the level is to be obtained and a constant voltage is obtained by means of apparatus at the power station, which is applied through wires to these resistance rods, and the current in the circuit, which varies with the water level, is arranged to work the instruments, so that their readings are directly proportionate to the actual water levels.

Venturi meters are arranged in the power-house, one per machine, for recording the quantity of water used by each main turbine. They were supplied by the British Pitometer Company.

SUB-STATION AND TRANSMISSION LINE.

The power from the 11-kV switchboard is led by underground cables to an outdoor sub-station situated alongside the power-house, where the voltage is transformed from 11 kV to 132 kV, and also to 33 kV—see Fig. 37 and Fig. 43, page 246. This outdoor sub-station is equipped with two 20,000 kVA, 132-kV transformers, which are connected in series with boosters, so that the voltage of the 132 kV line may be varied plus and minus 10 per cent. by the operator in the power-house. These transformers are insulated for the full line voltage throughout, and were designed to withstand a test pressure of 290 kV for 60 seconds, when hot.

Provision has been made in the sub-station for two further 20,000-kVA transformers and for the addition of automatic oil switches on the 132-kV side, should they be required in the future. The transformers and boosters, together with the earthing resistances and 132-kV switchgear, are of the B.T.H. manufacture.

The 33-kV sub-station, which is also out-of-doors, is situated adjacent to the 132-kV sub-station, and in it are two 5000-kVA transformers of the three-winding type, which supply the 33,000-volt system, the intermediate winding being arranged for 2200 volts for a supply to auxiliary transformers in the

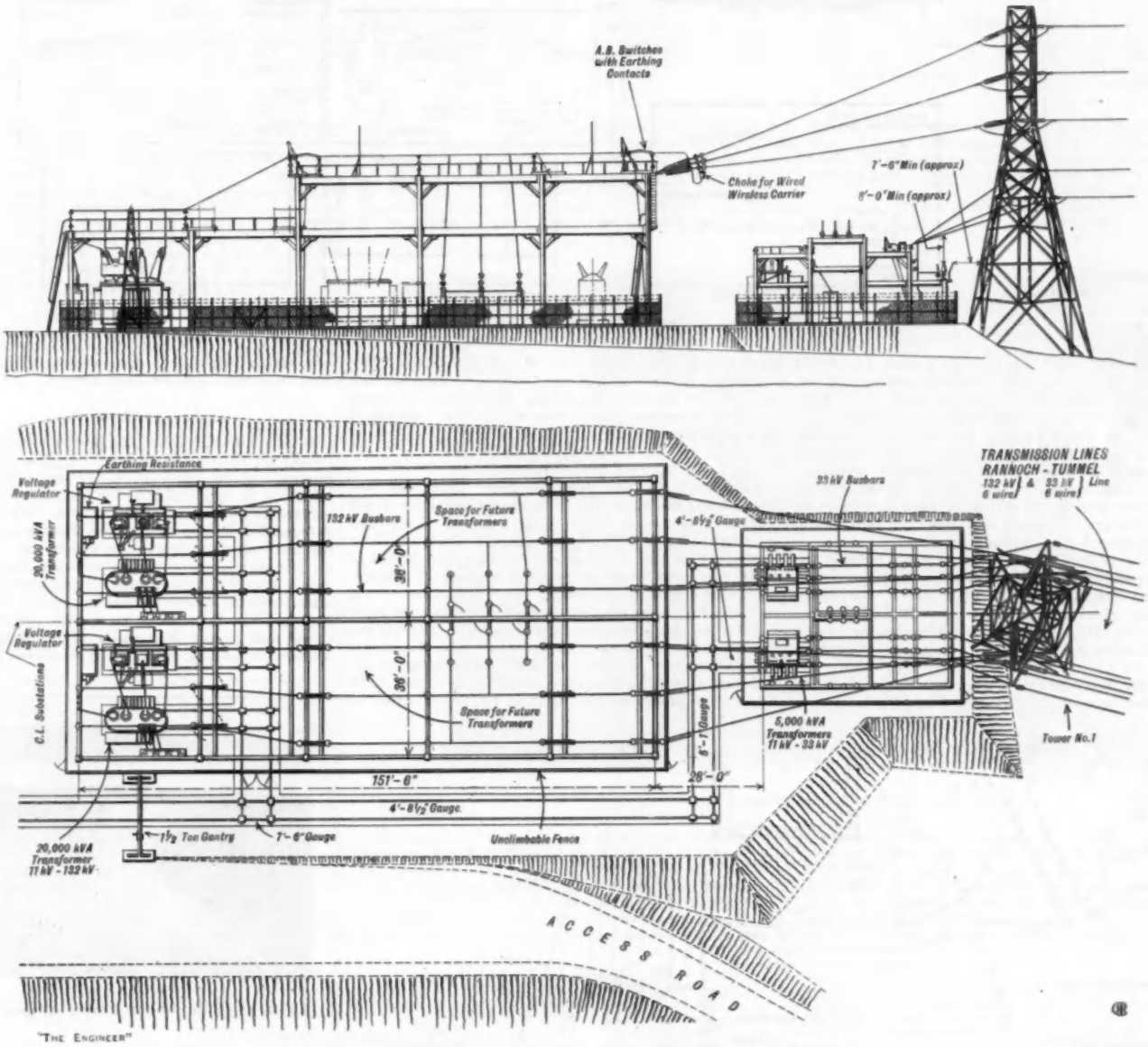


FIG. 37—SIDE ELEVATION AND PLAN OF OUTDOOR SUB-STATIONS

* No. IV. appeared August 28th.

power-house. The 33-kV transformers are of the Hackbridge Company's make and are fitted with Stragiotte on-load tap-changing gear, which is remote-operated from the power-house and arranged to give plus and minus 10 per cent. smooth variation in voltage.

The power from these two outdoor sub-stations is carried on a steel tower overhead line consisting of four circuits erected on the same tower, two 132-kV circuits being erected on the top and two 33,000-volt circuits underneath. The towers, which are of the Milliken pattern, were made by A. and J. Main and Co., Ltd., while the conductors, which are of steel-cored aluminium, were supplied by British Insulated Cables, Ltd. Each circuit is accessible with the others alive, and the height of the towers varies from 90ft. to 100ft. This tower line, which, it is said, constitutes the largest in the country, has a total carrying capacity of 112,000 kVA. It runs up to Tummel—approximately 17 miles from the power station—where the works for the second generating station are in progress as mentioned earlier in these articles. At that point the lines separate, the duplicate 33,000-volt lines continuing for a distance of about 50 miles or so into the area around Arbroath, while the duplicate 132-kV circuits are carried on in a southerly direction for a route length of about 60 miles to Abernethy Sub-station, which is situated near Perth. Each line is designed to carry 50,000 kVA. The connections of the transmission lines are shown diagrammatically in Fig. 38.

Abernethy Sub-station, it may be explained, is the junction between the Grampian Company's system and the Central Electricity Board's 132-kV "grid" system, and is equipped with two 20,000-kVA transformers. These transformers are of the three-winding type wound for 125 kV plus and minus 8 per cent., 33 kV and 132 kV.

The intermediate voltage winding supplies the local load from the 132-kV system without a direct connection having to be made from a separate transformer tapping and saves the expense and complication of costly 132-kV switchgear. The other windings couple the Grampian system, which is designed to work with a resistance in the neutral, to the "grid" system, the neutral of which is solid earthed. Tappings are provided on the 125-kV side for adjusting the normal working voltage of the Grampian system to suit the conditions on the "grid," and current transformers and potential transformers are connected for metering and protective gear arrangements. These three-winding transformers are notable, in that they are the largest of their kind in use in Britain. They were supplied by the B.T.H. Company.

The 33-kV local supply can be obtained from either transformer automatically without coupling the two main Grampian lines together through the 33-kV windings, so that if either line fails the supply is automatically obtained from the other.

The neutral point of the Grampian 132-kV system is earthed at one point only in compliance with a standing regulation, and a resistance is connected in the neutral point so that the maximum fault current is limited to a value which ensures the avoidance of excess voltage being induced in the G.P.O. telegraph lines which run parallel to the power lines. The resistance in the neutral also serves to increase the stability of the system during the period of earth faults and lessens the voltage "kicks" produced during such faults.

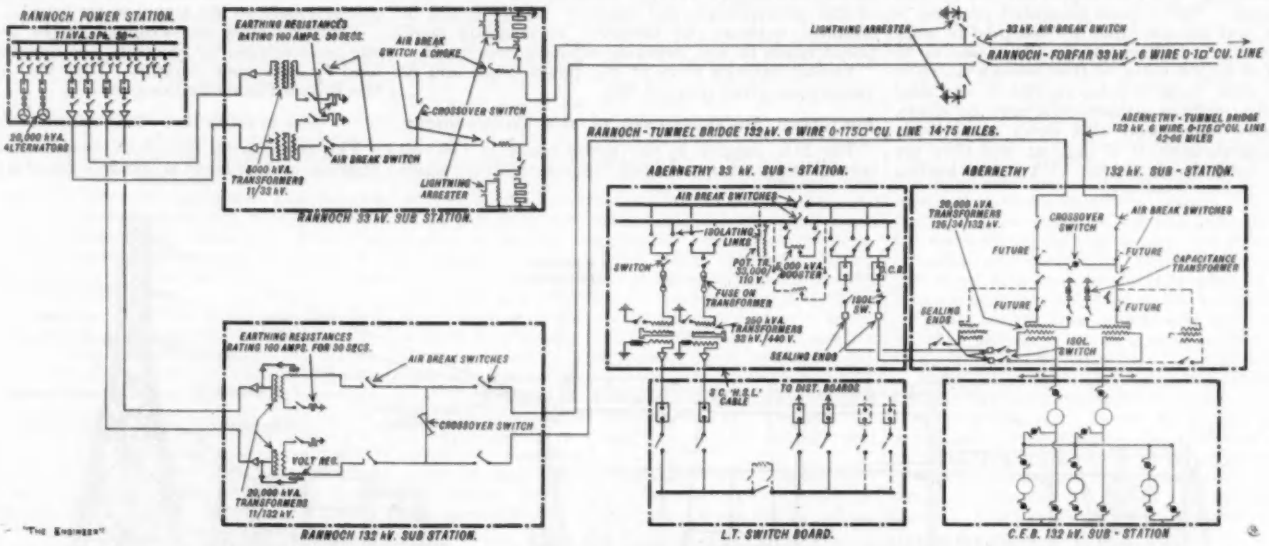


FIG. 38—DIAGRAM OF CONNECTIONS OF TRANSMISSION LINES

TAIL-RACE.

To return to the power-house. The tail-race which leads the discharge from the turbines into Loch Rannoch is about 340ft. long. It has been constructed to take the full discharge of three turbines. Each turbine has a draught tube discharge width of 17ft., the total width of the tail-race as it emerges from the power-house being 63ft. The sides of the race are curved in plan so that, at a distance of some 80ft. from the face of the building, the channel has been contracted to about 15ft. wide, that dimension being continued for just over 200ft. The invert of the tail-race at the face of the power-house is 658 O.D. From that point it rises in 32ft. to an elevation of 660 O.D. The next 20ft. are level and then comes a length of falling gradient for 38ft. 6in. at 1 in 16, the elevation of the invert at the end of the fall being 657·60 O.D. Thereafter the channel is, for a length of 211ft., given a downward gradient of 1 in 500, the invert level at the far end being 657·18 O.D. At that point there is a vertical rise in the invert level of 1ft. 3in. and a gradual rise to 660·00 in the next 20ft., after which, till the end of the race, which is carried some distance into the Loch, the floor is level—see Figs. 39 and 40 and the views on page 246.

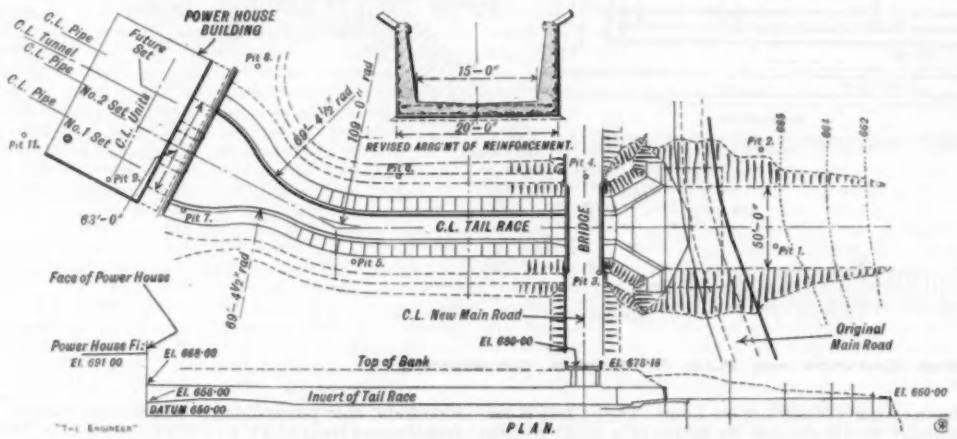


FIG. 39—ARRANGEMENT OF TAIL RACE

CONCLUSION.

In conclusion, we wish to tender our thanks to the Grampian Electricity Supply Company for giving permission for the publication of these articles, and for affording us opportunities for visiting and thoroughly inspecting the whole of the works. We also wish to express our thanks to Balfour, Beatty and Co., Ltd., for the valuable assistance which they rendered to us, not only during our inspections, but also in the preparation of these articles. The company, it may be added, which, under the chairmanship of Mr. George Balfour, has been associated with many large electrical and power generation undertakings, is noteworthy in having on its staff engineers capable not only of carrying out, but also—as in the present instance—of designing throughout such schemes as that described in the foregoing. The whole of the Grampian scheme was carried out under the immediate charge of Mr. A. M. MacTaggart, who is a director of the company. The power-house plant and the transmission line work were designed and carried out under the direction of Mr. A. S. Valentine, Mr. Ellacott being construction superintendent. The hydro-electric plant in the power-house and the pipe line were under Mr. E. M. Bergstrom, and the design of the extensive civil engineering works was in the hands of Mr. H. M. Gibb, Mr. R. A. Waddell being in charge of the construction of the works.

FIG. 40—TAIL RACE FROM POWER HOUSE

A MOST interesting publication has just been issued in the form of the first *Journal* of the British Wood Preserving Association. It is of some 100 pages and contains an account of the activities of the Association since its organisation late in 1929. The papers which have been presented before the Association are given verbatim, and contain a mass of information concerning the preservation of all kinds of timber in various parts of the world. The address of the Association is 166, Piccadilly, London, W. 1.

Metal Rectifier Applications.

THE best-known applications of metal rectifiers are those associated with wireless reception, which has done more to stimulate general interest in electrical affairs than anything else. But we propose to show in this article that this simple method of rectification is applicable in many other directions, and that currents and voltages considerably greater than those needed for wireless reception can be dealt with.

The simplicity of the metal rectifier becomes apparent when it is remembered that a disc of copper oxidised on one side by a special heat treatment constitutes the most important part. In the direction of oxide to copper, or, in other words, from the oxide face inwards, the electrical resistance is low, whilst in the other direction it is high, and when discs made in this way are connected in an A.C. circuit rectification occurs. As the action is purely electronic, there is no chemical action or wear. The discs are assembled on a screwed spindle, from which they are insulated by a sleeve of suitable material, and as the oxide surface is hard it has been found advisable to insert a lead washer between the oxidised face and adjoining conductor in order to equalise the load over the oxide surface. A similar washer is placed on the other side of the copper rectifying disc. Radiating fins are also provided to dissipate the small amount of heat evolved, and at the same time they serve as conductors, whilst in order to prevent the formation of air pockets between successive fins and consequent imperfect ventilation, a copper-plated spacing washer is provided between the successive radiating fins. The washers also permit of the use of a thinner gauge fin than would otherwise be possible without risk of the fins touching and short circuiting the washer. The rectifying discs and the other parts mentioned are tightly clamped together on the spindle by means of a nut, and a spring washer pressing on a reinforced moulded washer completes the insulation of the electrical components from the spindle and framework. By varying the assembly of the rectifier discs different rectifying circuits can be formed. Series connected units have been made to withstand 100 kV, whilst by paralleling the elements rectifiers have been built giving up to 1200 amperes for electro-plating.

When considering the important question of whether a transformer is necessary or not, it is to be remembered that a transformer serves two purposes—that of providing the correct voltage to give the D.C. output and that of isolating the A.C. and D.C. circuits. As it is common practice to earth the neutral of a three-phase four-wire system, as far as the domestic user is concerned, one pole of the 230-volt single-phase circuit is "live" to earth, whilst in the case of a three-phase, 400-volt supply each of the three lines is live to earth to the extent of 230 volts. Hence in the absence of a double-wound transformer, the D.C. circuit is "live" to earth, and must be suitably insulated. Often in the case of new installations it is convenient to dispense with the transformer, and to arrange for the D.C. apparatus to be suitable for whatever voltage is delivered by the rectifier when operating directly from the mains.

Typical voltage regulation curves for standard single and three-phase rectifiers working on a 400-volt supply and with the single-phase rectifier connected between two phases of the supply, are shown in Figs. 1 and 2. From no load to full load the voltage regulation is approximately 15 per cent., but it is said that it rarely happens that this characteristic is a disadvantage; in fact, it is often found to be desirable because the short-circuit current is low.

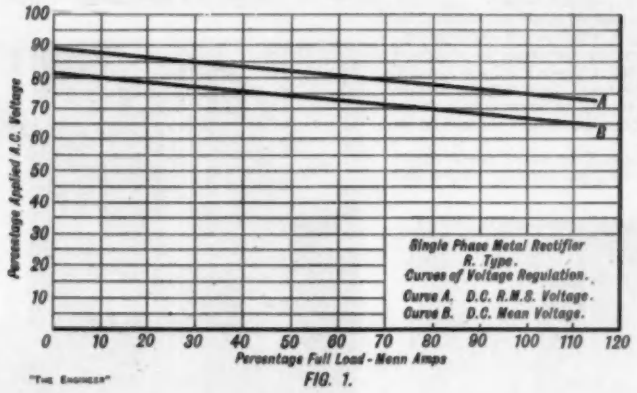


FIG. 1.

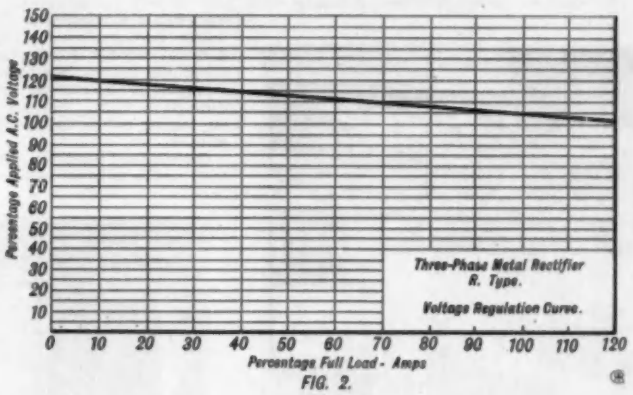


FIG. 2.

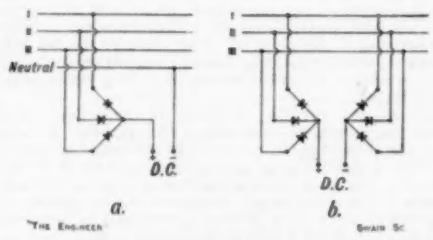


FIG. 3—RECTIFIER CONNECTIONS

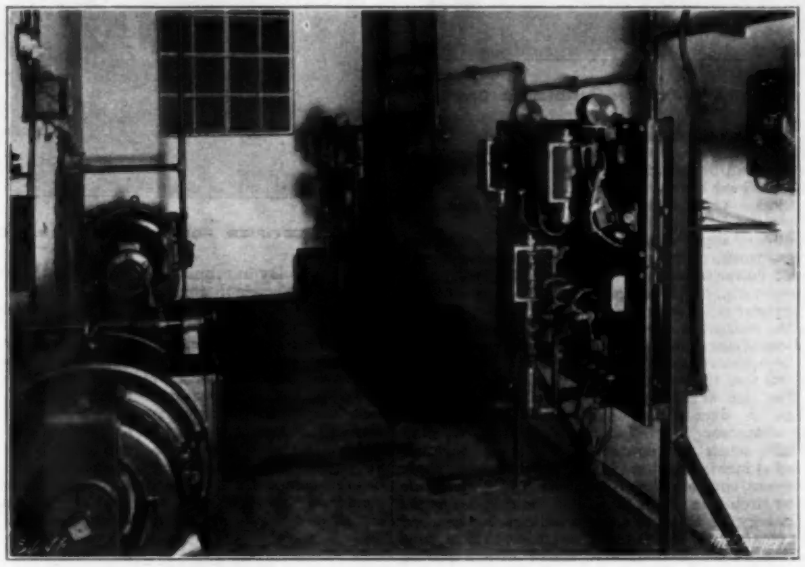


FIG. 56—LIFT EQUIPMENT WITH D.C. CONTROL GEAR

The mean D.C. voltage, as measured with a moving coil meter on a single-phase rectifier working at full load, may be taken to be 0·75 of the input R.M.S. voltage, when the D.C. circuit is inductive. The flux is proportional to the R.M.S. value of the current, while the current wave may be assumed to be steady with a superimposed A.C. component, which should be measured with a moving iron or similar instrument giving R.M.S. values. It has been found that in order to arrive at the same results as those obtainable when operating from an ordinary D.C. supply, some figure between the mean and R.M.S. values should be taken.

A belief exists that as the D.C. voltage is of a pulsating nature in inductive apparatus, the current and consequently the flux will pulsate correspondingly. If this were the case, the rectifier would be unsuitable for supplying D.C. to such apparatus as magnetic chucks, couplings, &c., and the resulting chatter would be objectionable for all purposes. Oscillograms show, however, that the D.C. current does not pulsate to a very great extent, even when the supply is drawn from a single-phase circuit. If arranged to give full-wave rectification a three-phase rectifier will produce a higher output voltage than the R.M.S. line input voltage, owing to the overlapping of the rectified voltage waves, and the current wave form is considerably smoother than that obtained with a single-phase supply. The voltage on full load is in the neighbourhood of 5 per cent. greater than the input line voltage. The regulation is the same as that of a single-phase rectifier, whilst the efficiency is somewhat higher. As a three-phase rectifier gives a smoother wave form than a single-phase rectifier, the former may be preferable for certain kinds of service. When current is supplied from a two-phase system, it is advisable to use a single-phase unit, connected from a Scott connected transformer is sometimes desirable. It is frequently essential that a half-wave rectifier should be used in conjunction with a condenser connected across the D.C. circuit in order to maintain the current during the suppressed half wave, the condenser being suitable for withstanding about twice the normal D.C. voltage. Connections for half wave and full wave rectifiers working on a three-phase supply are shown at *a* and *b* respectively in Fig. 3, whilst Figs. 4 and 5 are efficiency curves for a single-phase and three-phase rectifier.

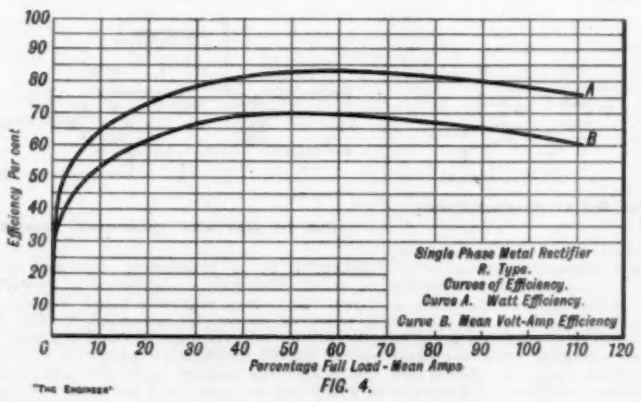


FIG. 4.

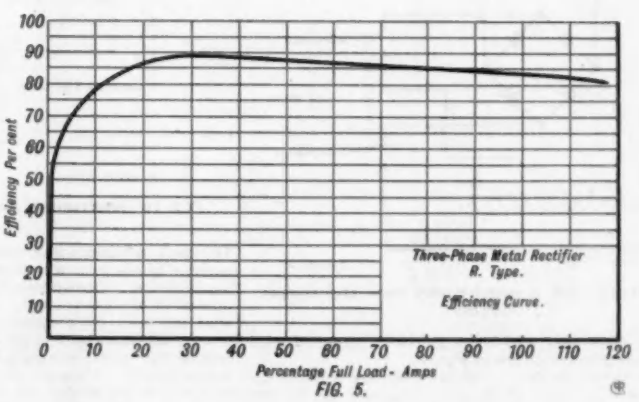


FIG. 5.

Damage to a metal rectifier can only arise from two causes—overheating by excessive current output or the application of a higher input voltage than that for which the rectifier is designed. Owing to the amount of metal in these rectifiers and the provision of the radiating fins for the dissipation of the heat, they are capable of dealing with overloads for short periods, and in the case of intermittent loading, a rectifier rated to give a considerably lower output than the peak demand may be used, but a limit to this reduction in capacity is reached when an excessive voltage is required to provide the peak current, owing to the drop within the rectifier. Extensive tests made by the manufacturers of these rectifiers—The

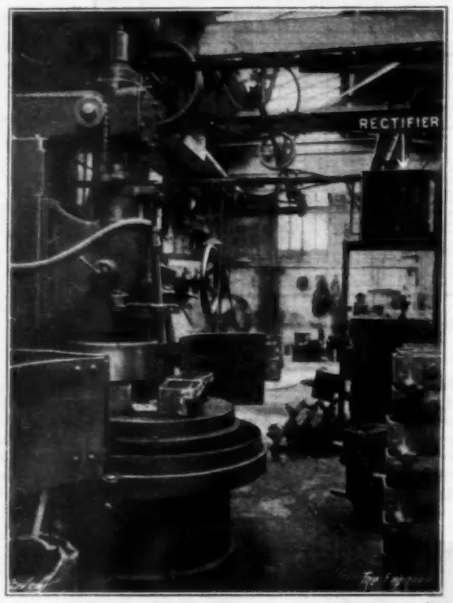


FIG. 7—RECTIFIER FEEDING MAGNETIC CHUCK

Westinghouse Brake and Saxby Signal Company, Ltd.—over a period of five years, are said to have shown that there is no deterioration or falling off in the output. The efficiency has remained the same as when the units were first put into service and the rectifying ratio has remained unaltered.

Coming now to applications other than those associated with wireless work, metal rectifiers are now widely used for supplying power to brake solenoids, gate lock solenoids, contactor coils, &c., of lift equipments. The noise created by A.C. apparatus is sometimes objectionable, but by rectifying the current it is eliminated. For the operation of lifts a three-phase motor may be used, whilst all control gear may be operated from a rectifier connected between two lines of the three-phase supply without a transformer. The rise in voltage on open circuit is advantageous, as it over-excites the contactor windings while the contactor is closing, and ensures a snap action, whilst when the contacts have come together and the load is increased, there is a slight drop in voltage, and the current consumption is reduced. It is desirable to break the circuit on the A.C. side of the rectifier as the inductive energy of the contactor windings is absorbed by the rectifier without risk of damage to the unit or bad arcing at the switchgear. Small lifts requiring up to 1 horse-power are often run entirely from a rectifier, which supplies the motor current as well as that for the brake and control gear. It is desirable to use a series brake which is definitely withdrawn before the motor commences to operate the lift. A Medway lift equipment

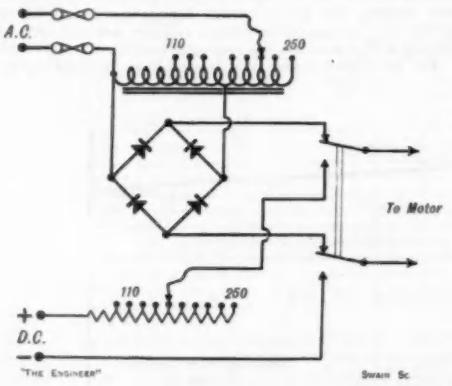


FIG. 8—RECTIFIER CONNECTIONS FOR UNIVERSAL MOTOR

with the control gear and break solenoids supplied with D.C. from rectifiers is shown in Fig. 6.

Metal rectifiers fed from a transformer are suitable for supplying power to the windings of magnetic chucks and similar devices, the rectifier usually being as cheap as a D.C. generator used for the same purpose and driven by nearby shafting. A magnetic chuck energised in this way and fitted to a grinding machine is shown in Fig. 7. As there is a constant pull on the work, chattering troubles are avoided. If switching is done on the A.C. side the inductive energy is absorbed by the rectifier and there is no appreciable arcing. For the supply of current to electrically operated valves, such as those associated with the automatic control of heat, the metal rectifier is also applicable. It is generally found more economical to employ a small rectifying unit for each valve than it is to use a large unit to supply a large number of valves, as the aggregate cost is less and regulating difficulties are eliminated.

When it is necessary to operate a motor on any commercial supply, as, for instance, a motor used in connection with a travelling showroom, the problem can be solved by using a D.C. motor operated from a rectifier and auto-transformer with tappings. This will enable the motor to be used on any commercial A.C. circuit, and if the motor be wound for a low D.C. pressure—say, 100 volts—it can also be made to work at any higher D.C. pressure by the use of series resistances, a practice which, although wasteful, is permissible in the case of small machines. The connections are shown in Fig. 8, which is self-explanatory. A metal rectifier is being used for operating the standard teleprinter telegraph equipment of the G.P.O., the rectifier supplying in this case the motor and the telegraph circuits through a filter. For the supply of high D.C. voltage for testing cables the metal rectifier is also claimed to be suitable.

Certain load conditions demand the use of series-wound D.C. motors in order to provide good starting torque and

FIG. 9—RECTIFIER FOR RAILWAY POINT OPERATION

minimum delay in running up to speed, as, for example, in the case of electric motors for operating points on railways, and where a reliable source of A.C. is available a metal rectifier may be used, whilst if an alternative supply can be obtained automatic change-over switchgear may be employed to bring the alternative supply into service in the event of the main supply failing. A 6-kW rectifier for point machine operation mounted on a sub-station switchboard and transformer cubicle on the L.M.S. Railway at Manchester is shown in Fig. 9.

As a rectifier provides a path of considerably lower impedance than that offered by a condenser and is said to be more compact and cheaper and to be more reliable than a condenser, it can be used with advantage in an inductive circuit as a protection against burning of switch contacts.

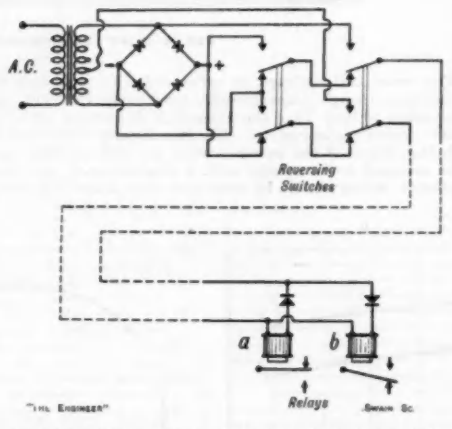


FIG. 10—RECTIFIER AND RELAY CONNECTIONS

The metal rectifier is also claimed to lend itself to supplying current to the field windings of alternators instead of the usual exciter. Rectifiers can be conveniently used for the operation of either of two electrical instruments with one wire for each by reversing the polarity of the applied power, an important application of the scheme being in connection with sub-stations operated from a central control panel. A simple circuit for operating either of two relays is shown in Fig. 10. When the current is flowing in one direction the relay *a* operates, whilst when the polarity is changed the relay *b* operates and *a* opens; if A.C. is used on the circuits both relays operate.

For electro-plating work metal rectifiers are claimed to be preferable to a double commutator generator driven by a motor, particularly as regards maintenance and efficiency. The first cost of the rectifier equipment may in some cases be greater than that of the heavy current generator, but the rectifier maintenance cost is practically nil. The control of the output is best obtained by a separate regulating resistance for each plating vat, whilst coarse control can be secured by connecting the rectifier to various tappings on the primary side of the transformer. As an out-of-balance load is troublesome, and as a three-phase rectifier has a better efficiency than a single-phase rectifier it is preferable to employ the three-phase type. For electrostatic precipitation metal rectifiers giving D.C. pressures up to 80 kV have been in use for nearly three years. The D.C. is obtained from a bridge-connected oil immersed rectifier operated from a single-phase transformer. There are many other applications of these metal rectifiers. They have been found, for example, to meet the requirements of laboratories in medical institutions and schools where low voltages and currents up to about 5 ampères

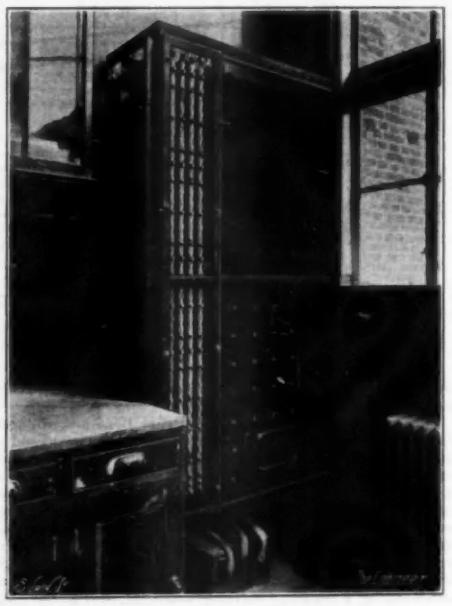


FIG. 11—LABORATORY RECTIFIER

are generally required. The equipment shown in Fig. 11 is in use in the Beaumont College, Windsor. It can give a continuous output of 130 volts at 30 ampères, and tappings are provided on the transformer to reduce the voltage to a lower value when current is supplied to the laboratory benches. By means of a change-over switch the rectifier can be cut out of circuit so that A.C. may be supplied to the benches.

As regards the use of metal rectifiers for charging batteries, it is to be remembered that the current passing into the cells varies directly as the difference between the voltage of the charging apparatus and the E.M.F. of the battery, and is dependent on the voltage of the supply mains. Unless the supply variations are compensated for the charging current will be found to fluctuate very widely. An increase of 3 per cent. in the supply voltage may cause an increase of 100 per cent. or more in the charging current, with damaging effects to the batteries and charging equipment. The back E.M.F. of the battery will vary to an extent depending on the condition of the cells, and in order to provide the required current some means of regulating the charging voltage must be employed. This may take the form of a variable resistance, a portion of which should remain permanently in circuit, as shown in the diagram *a*, Fig. 12. Alternatively a choke with tappings, as shown in the diagram *b* in Fig. 12, or an adjustable core may be used. On high power chargers the two latter devices are advantageous, as the losses involved are small compared with those

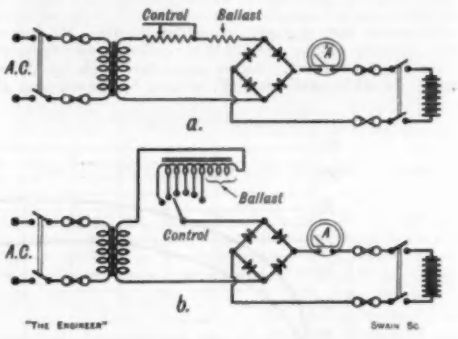


FIG. 12—BATTERY CHARGING CONNECTIONS

dissipated by a resistance; but for small chargers or trickle chargers a resistance is probably cheaper. When the voltage regulator takes the form of a choke it must, of course, be connected on the A.C. side of the rectifier. In the case of small chargers the use of a special transformer which incorporates a means of varying the leakage reactance is convenient and economical. The primary and secondary coils are wound on separate limbs, and a leakage path for the flux is provided by a movable core, which is arranged so that a variable air gap is provided between it and the main transformer core. The adjustment of the air gap varies the leakage flux, and hence the secondary voltage, producing a change in the charging rate. The residual leakage flux is sufficient to provide the necessary ballast for protection against fluctuations of the primary voltage. Large battery chargers are operated most economically from a three-phase supply, but minor complications are sometimes encountered in the regulation of the charging current. A three-pole

"ganged" switch may be used, operating in conjunction with three tapped chokes or tappings on the transformer, but it is essential that the three line currents should be equal, or there will be out-of-balance loads. A far more satisfactory method is to use a small induction regulator for varying the secondary voltage to give the required output—Fig. 13. The leakage reactance may be sufficient to act as ballast, but if it is not, a small choke or resistance should be connected in each lead. The regulator may replace the transformer.

When a battery is subjected to heavy intermittent loads

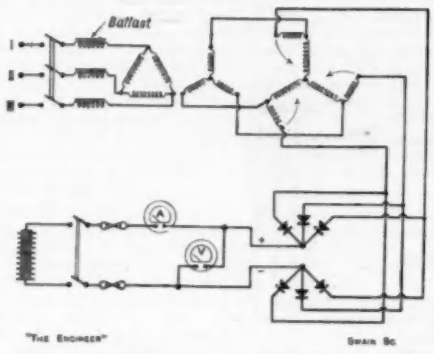


FIG. 13—INDUCTION REGULATOR CONTROL

whilst being trickle charged it is necessary to ensure that the load is properly shared by the two sources of power. The Westinghouse regulating equipment gives a very steep curve of current against voltage, and this feature protects the rectifier against overloads. Unless the battery is supplying telephone circuits, whilst being charged no smoothing circuit is necessary. A battery of relatively large size is frequently employed to supply heavy loads of short duration, which supplies no current for the greater part of its life. Under these conditions very little current has to be put into the battery to compensate for

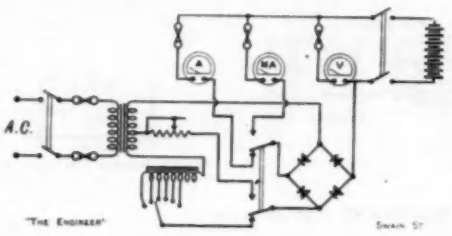


FIG. 14—CONNECTIONS FOR TRICKLE AND MAXIMUM RATE CHARGING

that taken out; but, nevertheless, the cells require a certain amount of regular charging. The best scheme under these conditions is to "trickle" charge the cells by continually passing a small current into them to compensate for the chemical waste, the method being applicable to both lead and nickel-iron alkali cells. When it is necessary to maintain a battery in a fully charged state by trickle charging and to charge it at the maximum rate after an occasional heavy discharge it may be convenient to use one rectifier for the two purposes, as shown in Fig. 14. Normally the range of regulation is covered by means of transformer

FIG. 15—RECTIFIER FOR CHARGING LIGHTING BATTERIES

tappings and fine regulation by means of a variable resistance or choke. As shown in Fig. 14, a separate ammeter is used to measure the trickle charge current.

Many metal rectifiers have been made for charging batteries of much larger capacity than those used for wireless work, and Fig. 15 shows an equipment designed to charge one to ten batteries used for omnibus lighting at rates governed by an induction regulator varying up to 25 ampères. The standby batteries for the emergency lighting equipments of theatres, hospitals, &c, are frequently trickle charged, and immediately a failure of the main supply occurs a contactor closes and the emergency battery is connected to the lighting circuit. In a similar way these rectifier charging equipments have been installed in wireless stations as, for example, at the G.P.O. Baldock receiving station, where speech is received from various parts of the world and is transmitted by land line. Other applications are in connection with telephone exchanges, electric clock installations, &c.

Pneumatic-Tired Rail Coaches.

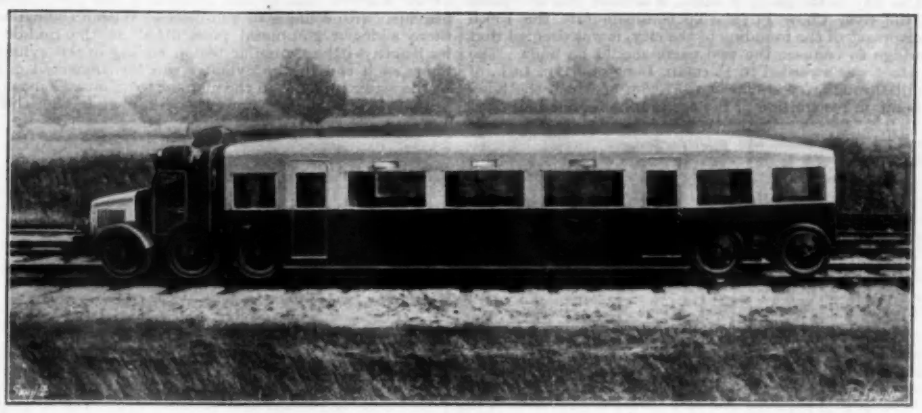
THE demonstrations of rail coaches on pneumatic tires, recently carried out by Messrs. Michelin et Cie, of Clermont-Ferrand, and particularly the runs with two types of vehicle on the line between Palaiseau and Chartres, were intended to show that local railways which are threatened by diminishing traffic and the competition of road motor cars can recover their activity by carrying passengers more quickly and more comfortably than can be done by road. The use of pneumatic tires for rail coaches is claimed to be advantageous for the reason that the coefficient of friction of rubber on steel is such as to allow the weight of the vehicle to be reduced considerably. This reduction is not only desirable, but necessary, because

PNEUMATIC RAIL COACH WHEEL

the tire has a narrow tread and the weight must not exceed 1400 kilos. per axle. The coach illustrated herewith is, therefore, of light construction. The demonstrations on an old track in a bad state of repair showed that the new coaches could travel at high speeds with great smoothness and silence. The wheel, as shown in the second engraving, is of the ordinary pressed steel disc type, used on heavy motor vehicles. The tire is of special form, in order to conform to the railway companies' specification limiting the overhang of the tire on each side of the rail head. The deflation of the tire in the event of puncture is prevented by a wooden hoop on the outer half of the tire between the cover and the tube, the arrangement being such that there is no load on the tube when the cover is held extended by the hoop. In case of puncture the release of pressure causes a piston in the inflation nozzle to move and make an electric contact, which, by means of a bell and horn in the cab, warns the driver, who changes the wheel in the same way as on a motor vehicle. The flange is dished out of a steel plate ring to clear the tire and is riveted to the wheel disc. Basing an estimate of tire duration on the experimental running of a coach at the works at Clermont-Ferrand during the past two years, the makers state that the wear is about 1 mm. for 10,000 kiloms.

The coach illustrated ran in the recent demonstrations, and is propelled by a 20 H.P. Panhard engine. The front bogie has three axles, the first being driven by the engine and coupled with the second axle by chains. It has six longitudinal springs and a damper for lateral movements. The rear bogie with two axles has four springs. The coach has four speeds both ways, the average top speed being 56 miles an hour. It is stated that the vehicle can be accelerated to 50 miles an hour in 600 m. from a standing start, and with hydraulically actuated brakes on all wheels it will stop from the same speed in 100 m. The weight of the coach is 4370 kilos., and it carries a load of 2160 kilos., representing twenty-four passengers. The consumption of petrol is stated to be 4½ gallons for 62 miles. The coach is really a motor omnibus on rails, and is handled in the same way. Because of its accelerating and braking capacities, it can be stopped at frequent intervals for taking up and setting down passengers. It is announced that the Chemin de fer de l'Est has ordered thirty of these 24-seater vehicles, and that the makers are now engaged on the construction of a 56-seater vehicle of similar design.

MICHELIN PNEUMATIC-TIRED RAIL COACH



SIXTY YEARS AGO.

IMPROVED forms of road transport were engaging much attention sixty years ago. The horse tramway, an American invention, was rapidly becoming familiar to urban dwellers. In our issue of September 8th, 1871, we recorded the opening of an extensive section of tramway line in London, namely, from Blackfriars Bridge to East Greenwich and Blackheath Hill. The cars ran at ten-minute intervals, and the journey to Blackheath occupied about 40 minutes. Elsewhere interest in tramways was being shown. From the same issue we learn that a proposal was on foot to construct a tramway from Howdon to North Shields, and that at Glasgow it was expected that work on the laying of about 9½ miles of double tramway lines would be begun within a fortnight. Even before the horse tramway had in this manner become a familiar sight in our principal cities, men were turning their attention seriously to the displacement of the horse from the road. There was still no thought of employing the internal combustion engine for that purpose. Everyone's ideas centred about the development of steam omnibuses and steam road tractors. In a leading article in the issue from which we are quoting, we commented upon certain trials that had been made at Wolverhampton with the Indian Government's steam train engine "Chenab," built by Ransomes, Sims and Head. The first trials, it seems, had proved a failure, and there were those who saw in that fact the postponement to a distant date of the time when it would be possible to use steam with certainty and advantage for the conveyance of passengers on common roads. We were not in agreement with that view. The original pot boiler of the "Chenab" had been changed to a Field boiler and the fuel had been altered from coal to wood. The result had been, we reported, that the engine was now capable of doing all that was expected of it and a little more. In addition, other designs of road steamer were being developed. Messrs. Robey had, we recorded, recently run a very successful trial of a steam omnibus between Grantham and Lincoln, and within the preceding few days we had ourselves taken part in a similar trial with a steam-propelled engine constructed by Mr. Burrell, of Thetford. There was no doubt about the fact that a large demand was arising for road steamers capable of drawing passengers and goods at speeds which, although more moderate than those common on the railways, would still supply more rapid locomotion than could be had with horses. There would, we were certain, be no difficulty in applying steam to that purpose, and we anticipated that there would soon be a large volume of business for British engineers in supplying the necessary vehicles, particularly for use in overseas countries and the Colonies.

THE Railway Returns for 1930 show that the number of steam, electric, and petrol locomotives at the end of the year was 22,798, representing a decrease of 656 in the twelve months. The total empty weight of the steam locomotives decreased from 1,079,716 tons to 1,062,943 tons, but the average empty weight per locomotive increased from 46·13 tons to 46·72 tons, principally as a result of the larger proportion borne by the heavier types of locomotives to the total number in stock. In 1928 the proportion of tender locomotives having six, eight, or ten coupled driving wheels was 74·43 per cent.; in 1930 it was 76·30 per cent. In 1928 the proportion of tank engines having six, eight, or ten coupled driving wheels was 68·17 per cent.; in 1930 it was 69·92 per cent.

Carrying a Water Main Across a Bascule Bridge.

THE city of Bangkok, in Siam, is divided into two parts by the river Chow Phya. To commemorate the 150th anniversary of the founding of the city, it was decided that a bridge to connect the two parts should be built. The contract was awarded to Dorman, Long and Co., Ltd., of Middlesbrough, for a sum of £267,288, of which the King of Siam, in recognition of the occasion, paid one-half from his privy purse. Work was started upon its erection in the summer of 1930. In order to allow for the demands of navigation, the bridge, which was recently completed, has a central opening span of the double bascule type, giving a clear span of 60 m. in length, while the approach spans are each 85 m. long. It carries a roadway 10 m. wide, and two footways each 2½ m. in width.

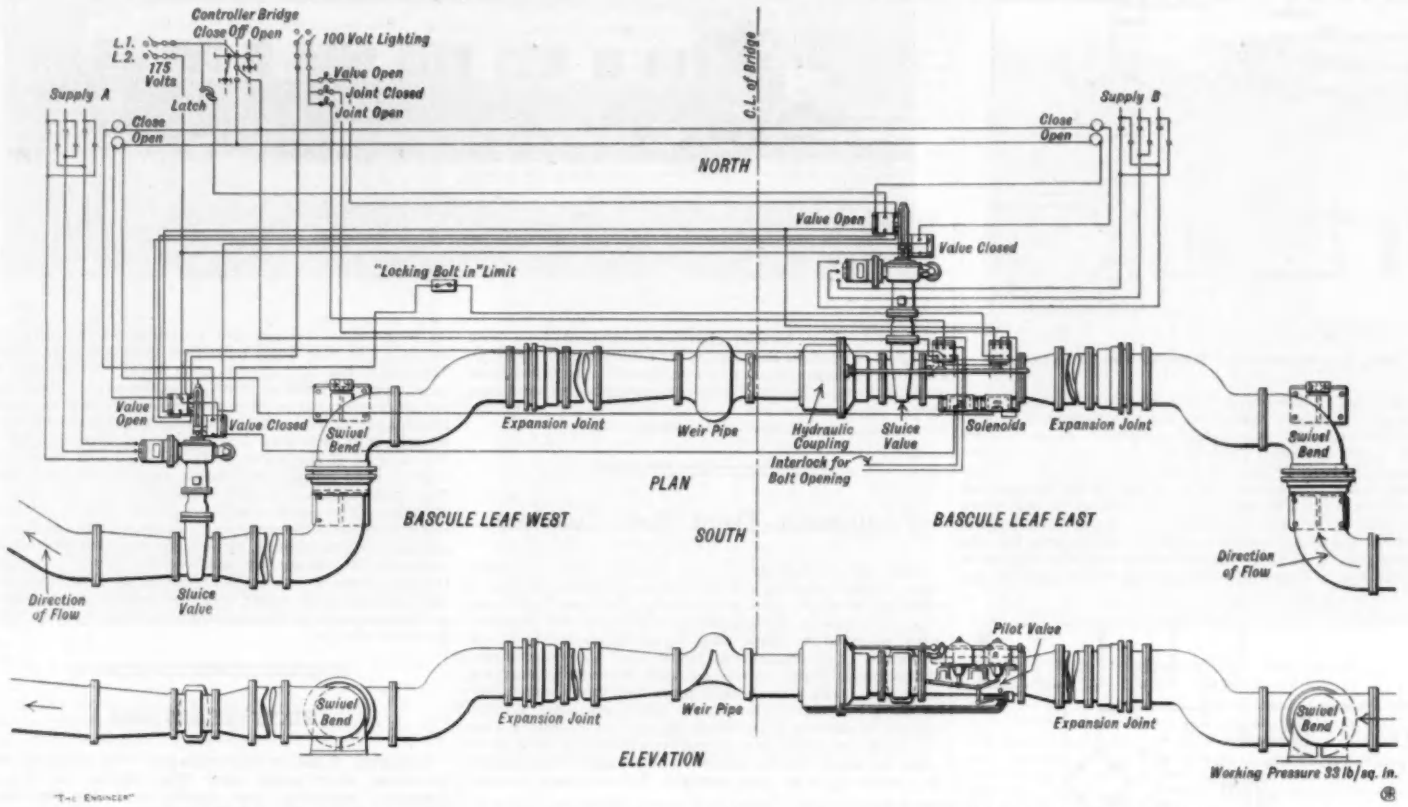
The opportunity provided by the erection of the bridge was taken to carry across the river a water main to supply that part of the city on the western side with water from a reservoir on the eastern. Owing to the fact that the native boatmen navigating the river throw out drag anchors to retard their progress as they are carried along by the rapidly flowing current, it was impossible to lay the pipe line on the bed of the river. It had therefore to be carried by the bridge, and since that was of the bascule type, means had to be provided for breaking and re-making the pipe line whenever the bridge was opened and closed. The drawing on this page shows in plan and elevation the arrangement of the pipe line on the two bascule leaves. This equipment was provided by Glenfield and Kennedy, Ltd., of Kilmarnock.

At the end of each bascule leaf and placed approximately upon the axis of rotation, there is a swivel bend in the pipe line. Between each bend and the centre of the span there is fitted an expansion joint, which is arranged to compensate for any slight axial movement that may arise, owing to inexact alignment of the swivel bend and the axis of rotation. At the centre of the span there is a specially designed hydraulic coupling. At the outer end of the Eastern bascule leaf there is a cast iron cylinder provided with a lining of gun-metal. Within the cylinder there slides a gun-metal pipe, fitted at the middle of its length with an annular piston sliding in the cylinder. Since each end of the cylinder can be connected either to the water pressure in the main or to exhaust, a means is provided for forcing out or withdrawing the sliding member. The joint between the movable pipe and the end of the main on the other leaf of the bridge is made by means of a heavy rubber pad held rigidly in a special ring formed on the end of the pipe. The proportions of the joint are such that compensation for inexact alignment is provided, and some latitude in the length of the stroke of the sliding member is allowable. The moving part of this hydraulic coupling can be seen in the photograph we reproduce on this page. Immediately-behind the operating cylinder of the coupling there is an electrically operated sluice valve. A similar valve is situated on the landward side of the swivel bend of the Western bascule leaf, which carries at its outer end a swan-necked weir pipe provided to prevent water flowing out when the coupling is open and the span is being raised. The arrangement of the pipe line on the Western side differs from that on the East, owing to the fact that the static head of the water in the pipe line on the West is low. In consequence, if the sluice valve on this side had been placed at the outer end of the bascule leaf, it would have been raised to a level much above the free surface of the water when the bridge was opened. The water would then have retreated from the valve and a risk would have occurred of air leaking into the pipe line to cause trouble when the bridge was again closed. With the arrangement shown in the drawing, very little water is lost, but chutes are provided to carry away any that may pass, and so prevent the occupants of boats below from getting wet.

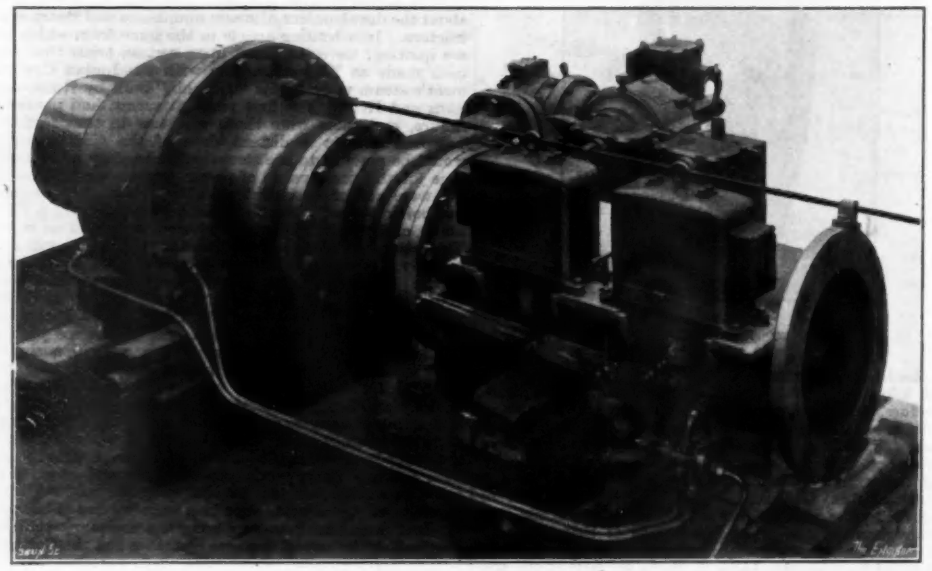
The sluice valves and the hydraulic coupling are operated and controlled electrically, arrangements being so made that the controls are interlocked with those of the bridge to ensure that all the operations of closing the valves, opening the coupling, opening the bridge, &c., occur in the correct sequence. The electrical connections that ensure this sequence are shown in the drawing.

On moving the control drum for opening the bridge, the circuit is made to the closing contactors of the sluice valves on both sides of the river, and when fully closed, each valve is stopped by its own limit switch. These switches are of the two-way type, and when both are closed they complete the circuit for the solenoid operating the control valve of the hydraulic coupling, which is moved to the fully open position. When the joint opening movement has been completed, the control rod seen in the engraving projecting through the cover of the annular cylinder trips the two-way open limit switch, thus de-energising the opening solenoid controlling the pilot valve, and also completing the circuit for the bridge operating gear. At the same time signal lamps are illuminated in the control cabin showing that the joint is open and valves closed, in readiness for the bridge to open. On closing the bridge the controller is thrown in the opposite direction, and as soon as the locking bolt is fully home, the circuit is completed to the solenoid controlling the closing movement of the hydraulic coupling. When closed, the coupling limit switch is tripped, thereby completing the circuit for the contactors for opening the valves, which, when fully open, stop automatically by tripping their limit switches, and the cycle of operations is completed by releasing the control handle. The signal lamps then indicate that the joint is shut and the valves open.

The makers of the equipment for this gear inform us that the bridge was recently thoroughly tested, with very satisfactory results.



ARRANGEMENT OF THE PIPE LINE OVER THE CENTRAL OPENING SPAN SHOWING ELECTRICAL CONNECTIONS



HYDRAULIC COUPLING AND ELECTRICALLY-OPERATED SLUICE VALVE

AN additional supply of water for the city of Detroit will be taken from the Detroit River by a tunnel, 12ft. in diameter, and pumped to the purification works. Eight vertical-shaft, electrically driven centrifugal pumps, each with a capacity of 60 million gallons daily, are arranged in a circular pit at a level 40ft. below the water level of the river, the motors being on a working floor 10ft. above water level. This pit was formed by sinking a large concrete caisson 91ft. in diameter, the enclosed material being excavated as the caisson went down, its cutting edge being finally about 60ft. below water level, and 115ft. below the ground surface. A 12ft. concrete slab then made the floor level with that of the tunnel. The caisson wall is 8ft. thick. Inside this is a circular wall 4ft. thick, leaving a 5ft. annular space, which is divided into vertical compartments. The suction flumes below the pump floor enter some of these compartments, which serve also as surge chambers, the surges spilling over weirs into discharge conduits. The pumps discharge into others of these compartments, in which the water rises and flows over weirs 4ft. below ground level, from which it has a gravity flow to the purification works. For effective control of the quantity of water, six of the pumps are driven at constant speed by synchronous motors, while two are driven by slip-ring induction motors with variable-speed control. The pump runners or impellers are designed to operate under 60ft. head. Valves in the suction and discharge pipes permit of isolating any pump for inspection or repair, while sluice gates at the intakes of the suction pipes permit of closing these suctions in case the valves need attention. An electric travelling crane will handle the sluice gates.

Railway and Road Matters.

SOME important changes in the civil engineering staff of the London, Midland and Scottish Railway are announced. Mr. S. O. Cotton, the district engineer at Bradford, has been appointed divisional engineer at Manchester, a position now held by Mr. E. H. Townshend, and Mr. James Alexander, now chief assistant to Mr. Townshend, has been appointed to succeed Mr. Cotton.

AN extension of the interavailability of rail and road transport facilities on the Great Western has permitted that company to point out that it was the pioneer of passenger omnibus services in the British Isles, and opened the first service betwen Helston and the Lizard on August 17th, 1903. The company also claim to be the first to introduce interavailability of road and railway tickets, between Corwen and Llangollen, in July, 1927, while the rail-road service between London–Oxford (rail), Oxford–Cheltenham (road), started in October, 1928, has become so popular as to necessitate the employment of four super-saloon coaches daily.

A STUDY of the census of railway servants—mentioned herein on August 21st—shows that of the reduction of over 40,000, the Great Western contributed 2800, the London and North-Eastern 15,000, London, Midland and Scottish 19,000, and the Southern 3000. The number of drivers was reduced from 36,989 to 34,719, and of firemen from 34,792 to 32,486; but, as the engine cleaners have only dropped from 8992 to 8521, it may be assumed that many firemen have been put back to cleaning, and, naturally, drivers to firemen. Goods guards total 14,559, as against 15,666. Officers and clerical staff have been reduced from 71,060 to 69,035, and signalmen from 27,596 to 26,837. A significant reduction is in the permanent way men, who now number 59,542, as compared with 61,557. On reference to some earlier returns, we find that in 1925 there were 66,480 permanent way men.

THE challenge thrown down to British railways by the "Royal York" express of the Canadian Pacific, covering a distance of 124 miles in 108 minutes, or an average of 68·89 m.p.h., and so gaining the title of the fastest train in the world, has been accepted. The honour hitherto has lain with the Great Western 3.45 p.m. Swindon to Paddington, which covers those 77¼ miles in 70 minutes, or an average of 66.21 m.p.h. Now, as from September 14th, the distance is to be covered in 67 minutes, which brings the average to 69·18 m.p.h. This train would appear to be a favourite for making tests of this character. In pre-war days it ran from Kemble to Paddington, 91 miles, in 103 minutes, or exactly 53 m.p.h. After the war it called at Swindon, and then covered the distance to Paddington in 85 minutes, equalling 54·53 m.p.h. On July 6th, 1923, 10 minutes were deducted and the speed then became 61·80 m.p.h., and at that it remained until July 8th, 1929, when the above-named 66·21 m.p.h. was established.

As Mr. J. H. Thomas, whose resignation from the National Union of Railwaymen has just taken place, has been for some years one of the principal leaders in trades unionism, some particulars of his service as a leader of railway labour may be welcomed. Mr. Thomas is a practical railwayman, having served as a cleaner, then fireman, and finally as a driver on the Great Western. His first office in trades unionism was as the South Wales organising secretary of the Amalgamated Society of Railway Servants, and it is significant that he was the president of that body in 1910 and signed, as assistant secretary, the agreement of August 19th, 1911, that terminated the general railway strike of the preceding day. Mr. Thomas gave evidence on August 30th before the Royal Commission which was a sequel to that strike and of which, it may be noted with interest, Mr. Arthur Henderson was a member. When the four unions of railwaymen, outside the Associated Society of Locomotive Engineers and Firemen, were formed into the National Union of Railwaymen in February, 1913, he was appointed the first assistant secretary. Before the Departmental Committee which inquired, in the summer of 1914, into the working of the Railway Employment (Prevention of Accidents) Act, 1900, Mr. Thomas was the first witness for the men and gave evidence on July 5th, 1914. On the resignation of Mr. J. E. Williams, he was, in December, 1918, made the general secretary, and perhaps the most outstanding event of that period was when he and Mr. Lloyd George, on the afternoon of Sunday, October 5th, 1919, ended the strike which broke out with great suddenness on September 26th.

ON page 446 of THE ENGINEER of October 24th last we suggested, as a result of what was to be seen at the end of No. 1 platform at Euston, that efforts were to be made to avoid a repetition of the buffer stop collision in that road on September 1st previously, by the provision of a sand drag. The anticipation rather interested us, as a sand drag meant the shortening of a road which is only just long enough to hold some of the expresses, the engines of which have to be taken close to the buffer stops in order to accommodate the whole of the train at the platform. A visit at the time of the Leighton Buzzard accident inquiry showed, by the depth of the excavation, that something different was being attempted, and when there on Saturday, August 29th, we saw that there had been installed a similar buffer stop to one it was our pleasure to inspect at Hither Green on the Southern Railway in November last. It is known as the Jaeger, and is of German origin. For a length of 30ft. or so approaching the buffer stops, each of the two running rails has two other rails—one on each side—which rest on and are secured by clips to the sleepers. The buffer stops are attached to these subsidiary rails, and they have another member that rests on the running rails. Should the stops be struck unduly, they are carried forward and drag with them the additional rails and the sleepers; the friction set up between the latter and the ballast helps to retard the train. The running rails do not move, as the stops are not attached to them, and the weight of the engine acts as a brake on the sleepers moving forward. The sleepers are engaged gradually, which is a further checking effect. Immediately in the rear of the additional rails some half a dozen sleepers are closely spaced. These follow the other sleepers when drawn forward, so as to carry the road and prevent a gap in the sleeper support for the running rails.

Notes and Memoranda.

BY means of a combination of steamship and aeroplane services it is now possible to get from London to Los Angeles *viâ* Montreal in six days, and to Buenos Aires in fifteen days.

WHAT is described in the *Iron and Coal Trades Review* as being the longest and thickest rope installed on a main haulage road in this country is to be put down the William Pit at Whitehaven. It is 13,500 yards long, 1¼in. in diameter, and weighs 35 tons. The main haulage road on the William Pit goes a long distance under the sea.

ACCORDING to data collected by the American Railway Association, the railways of the United States have considerably reduced their coal consumption within the last ten years. While in 1920 it was 197 lb. per 1000 gross ton miles, it was reduced to 138 lb. in 1930. For passenger trains the coal consumption was reduced from 18·8 lb. per carriage mile to 14·7 lb. in the same interval.

IN the course of a lecture before the American Society of Mechanical Engineers, Mr. J. A. Keith, of the Kansas City Power and Light Company, said that a year's use of the experimental high-temperature superheater at Detroit had shown calorised low-carbon steel tubes to be quite effective in resisting high temperatures both outside and inside the tube. While the year's use seemed to show some thinning of the outer calorised coating, it was believed to be in such condition that a very reasonable life could be expected from the calorised units.

ACCORDING to an article in the *S.A. Mining and Engineering Journal* on "Rand Mine Air: Improving Conditions," based on a report by Mr. A. McEwen, Secretary to the Committee on Mine Air, an investigation was made into the probation period necessary for the acclimatisation of miners to work at high temperatures. A long series of observations was made in a disused drive in Springs Mines. The results showed that normally a period of about four days' continuous work at a reduced output in a hot place was sufficient for a worker to become acclimatised to producing a full output of work in the same conditions.

ACCORDING to the *India Rubber Journal*, a new rubber-bound paint has been produced by Mr. L. Cresson, technical manager of the Singapore Rubber Works, Ltd., Singapore. It is to be given a test on the front of the Government offices there. The paint, it is said, is unaffected by, and dries rapidly on, new plaster or concrete. It has high abrasive qualities, particularly the special grade, which is designed for the painting of floors, and it is possible to wash any stains off, even ink. A special grade of paint is made to improve the acoustic properties of any room. The paint is supplied in concentrated form, which is easily diluted with cold water for application. The rubber content of the general type of paint for interior and exterior decorative work is approximately 5 lb. per 1000 square feet per coat of paint, and generally it is more satisfactory to apply two coats. The cost of production is stated to be less than that of ordinary paint.

WHILE it is true that ignitions of inflammable gas in coal mines by shot-firing are few in relation to the number of shots fired, they have engaged the continual attention of research workers on account of their persistence from year to year, and the possibility of serious consequences in every instance. In the latest publication of the Safety in Mines Research Board, "The Ignition of Fire-damp by Coal-mining Explosives," by H. C. Grimshaw and W. Payman, particulars will be found of experimental work dealing with all matters which should be of interest to users of coal-mining explosives. It is established that the risk of ignition is increased by placing the detonator at the closed end of the bore of the cannon which in the gallery experiments represents the shot-hole, or by decreasing the effective length of the bore. The effect of the position of the detonator is strikingly brought out both in the tables and flame photographs. The publication—S.M.R.B. Paper No. 69—is on sale through H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1s. 6d. net.

IN America lift dispatchers are being employed to ensure the regular running of lifts and to expedite the service. One authority considers the service excellent when the interval is eighteen seconds between cars leaving the first floor with eight cars in a bank, and thirty seconds interval between cars with four cars in a bank. The service is classed as fair when the interval between cars is twenty-four seconds with eight cars in a bank and forty seconds with four cars. This takes into consideration the round-trip time, which is a measure of the average time required for passengers to reach their floors after entering the building. Although automatic scheduling of the cars improves the service, it does not, says *Power*, ensure that the cars will always run on schedule. The number of calls in a given period may vary widely. One car may have calls on each floor when the following car has none. For this reason the dispatcher is provided with a floor call and a car position indicator. When the dispatcher sees that a car is falling behind its schedule some of its calls are by-passed to the following car and in this way the schedule is maintained.

IN view of the fact that the total hydraulic installation of the Dominion now averages 617 H.P. per 1000 of population, a figure which places Canada in an outstanding position amongst the water power using countries of the world, it is, says the *Canadian Engineer*, interesting to note the trend in development in the various provinces. In order of installation per capita, development is as follows:—(1) British Columbia, 630,792 H.P., 597,000 population, 1·057 H.P. per capita; (2) Quebec, 2,718,130 H.P., 2,734,600 population, 0·994 H.P. per capita; (3) Yukon and North-West Territories, 13,199 H.P., 13,300 population, 0·922 H.P. per capita; (4) Ontario, 2,088,055 H.P., 3,313,000 population, 0·630 H.P. per capita; (5) Manitoba, 311,925 H.P., 671,500 population, 0·465 H.P. per capita; (6) New Brunswick, 133,681 H.P., 423,400 population, 0·316 H.P. per capita; (7) Nova Scotia, 114,224 H.P., 553,900 population, 0·206 H.P. per capita; (8) Alberta, 70,523 H.P., 600,000 population, 0·107 H.P. per capita; and (9) Prince Edward Island, 2439 H.P., 85,800 population, 0·028 H.P. per capita.

Miscellanea.

IT is suggested that the British Empire Industries Exhibition may be held in Vancouver in 1936.

THE Public Utilities Committee of Winnipeg has set the date of the official opening of the Slave Falls power development at September 1st.

IT is proposed to expend 10,000,000 dollars on the construction of a high-speed electric line across the Delaware River Bridge at Philadelphia.

A NEW gift of 250,000 dollars has been made by Mr. Ambrose Swasey to the Engineering Foundation of America, bringing the total up to 750,000 dollars.

THE Newcastle-upon-Tyne Electric Supply Company, Ltd., has decided to close down its coal distillation plant at Dunston-on-Tyne, where experiments have been proceeding for the past few years.

THE yield from the oil wells of the Burbach Kaliwerke A.G., of Germany, is said to have been increased from 60 to 400 tons a day, and it is anticipated that it can be worked up to 2000 tons a day.

A TOTAL of 10,000 acres of pine and softwood forests have been planted in New South Wales. The State Forestry Commission estimates that in forty years Australia will be able to meet all her own requirements for softwoods.

THE production of gypsum in Canada during 1930 totalled 1,040,883 tons, valued at 2,772,584 dollars, and in 1929 the output was 1,211,687 tons, valued at 3,345,696 dollars. Exports of gypsum in 1930 were 726,662 tons and imports 17,725 tons.

THE Birmingham section of the British Industries Fair is being extended at an estimated cost of £16,000. One and a-half acres of old buildings are being taken down and 3 acres erected, including the covering of the area previously occupied by the old buildings.

ARRANGEMENTS are being made to start work again on the sulphur deposits of the Ketscheborlu Region of Turkey. It is proposed to produce 10,000 tons a year, and as the Turkish consumption of sulphur is only 5000 tons a year, there will be a considerable margin for export.

VICKERS-ARMSTRONGS have completed at Barrow shipyard the turbo electrically-propelled liner "Strathnaver," and she left Barrow docks on Wednesday last for Liverpool in order to proceed to the Clyde for trials. Her tonnage is 22,000 gross, and she is the biggest merchant steamer ever built at Barrow. A sister ship, the "Strathaird," is now fitting out in Barrow docks. Both liners are intended for the P. and O. service between London and India, and Australia. With a speed of 22 knots, they will be the fastest vessels on that route.

SPECIAL opportunities for dealing with the matters contained in the reports of Sir Francis Goodenough's Committee will occur in July next year, when the International Congress on Education for Commerce will be held in London, as a result of the invitation given by the British delegation to the last Triennial International Congress, held in Amsterdam in 1929. The Congress is being organised by the British Association for Commercial Education, which is being formed as the outcome of the Amsterdam Congress, with Sir Francis Goodenough as chairman.

THE Department of Commercial Products of the City of London College announces a course of twenty-five lectures on iron and steel, to be given by Mr. T. Barton Kelly, on Thursdays, from 6 p.m. to 7 p.m., starting on September 24th next. The fee for the course is 25s. 6d. A college examination in iron and steel will be held at the conclusion of the course, and short course certificates awarded to successful students. In the event of a sufficient number of students presenting themselves, a short course of lectures on special steels and non-ferrous metals might be arranged.

CANADIAN construction firms have been invited to tender on a 1,000,000 dollars construction project to be carried out in the harbour of Pelotas, in the state of Rio Grand do Sul, Brazil. The work to be done consists of dredging and excavating work, the estimated amount being 935,000 cubic metres, construction of concrete wharves totalling 820,000 m. in length, the erection of three sheds with a combined area of 4,800,000 square metres, the placing of 2,130,000 m. of railway tracks, laying 28,000 m. of pavements and the installation of ten electric cranes.

THE Introduction of Customs facilities at Heston Air Park in March, 1930, has met with so favourable a response by owners of private aeroplanes that the arrangements now provided for the clearance of passengers and freight are to be permanent. The aerodrome will therefore be known in future as "Heston Air Port." There will thus be eight air ports in all in England, viz.:—Croydon, Heston, Lympne (Kent), Barton (Manchester), Liverpool, Cardington, Dover, and Woolston (Southampton). Of these, Liverpool is for passengers only, Cardington for airships, and Dover and Woolston for seaplanes. By the end of May, Heston had handled more traffic than Lympne, being in this respect second only to Croydon, whose traffic Heston is designed to relieve. In all, 1051 pilots have cleared Customs at Heston, and in a fine month the average figure is over 100.

A REPORT on the cost of the proposed Dartford-Purfleet Tunnel has been presented to the Kent County Council. Of the estimated cost of £3,500,000, £2,625,000 will be provided from the taxation of motorists, £250,000 each by the Kent and Essex ratepayers, £150,000 by the County of London ratepayers, £25,000 by Middlesex ratepayers, while the balance of £200,000 will be obtained from tolls. Road approaches will involve £170,000 on the Essex side and £400,000 on the Kent side, 60 per cent. of which will probably be borne by the Ministry of Transport. Lord Cornwallis, the Chairman of the Kent County Council Special Committee, stated that a larger sum might have to be obtained from the tolls, as the Port of London Authority had objected to the depth of the tunnel, and a further £300,000 would probably be added to the total cost of the scheme, £200,000 of which would have to be raised through the tolls.

THE GRAMPIAN HYDRO-ELECTRIC POWER SCHEME

BALFOUR, BEATTY AND CO., LTD., LONDON, ENGINEERS AND CONTRACTORS

(*For description see page 239*)

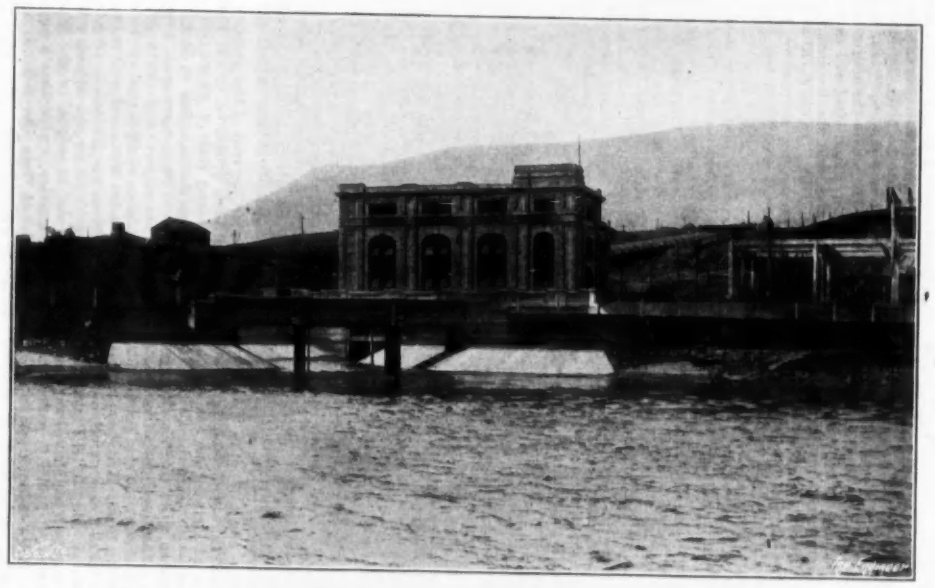


FIG. 41—GENERAL VIEW OF POWER HOUSE, PIPE LINE IN BACKGROUND

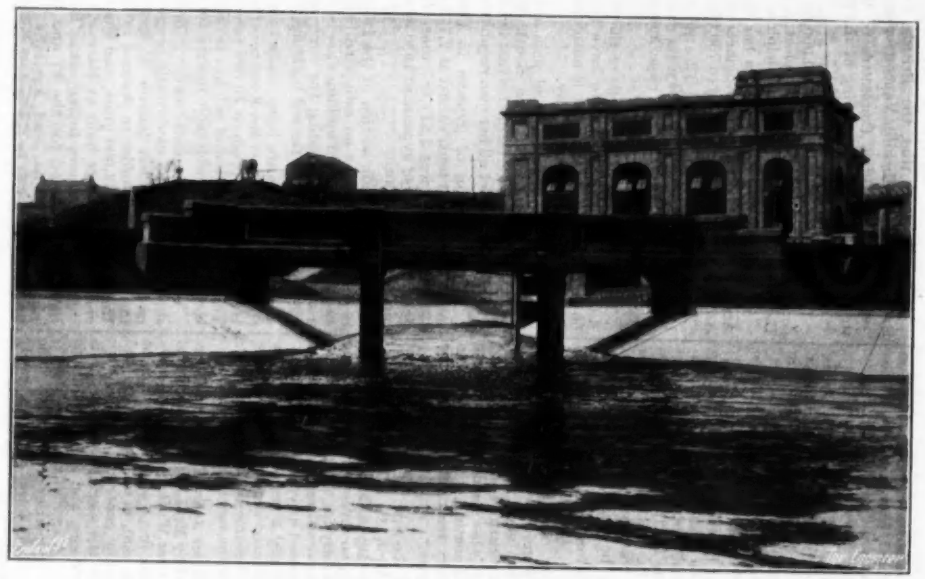


FIG. 42—REINFORCED CONCRETE BRIDGE OVER TAIL RACE

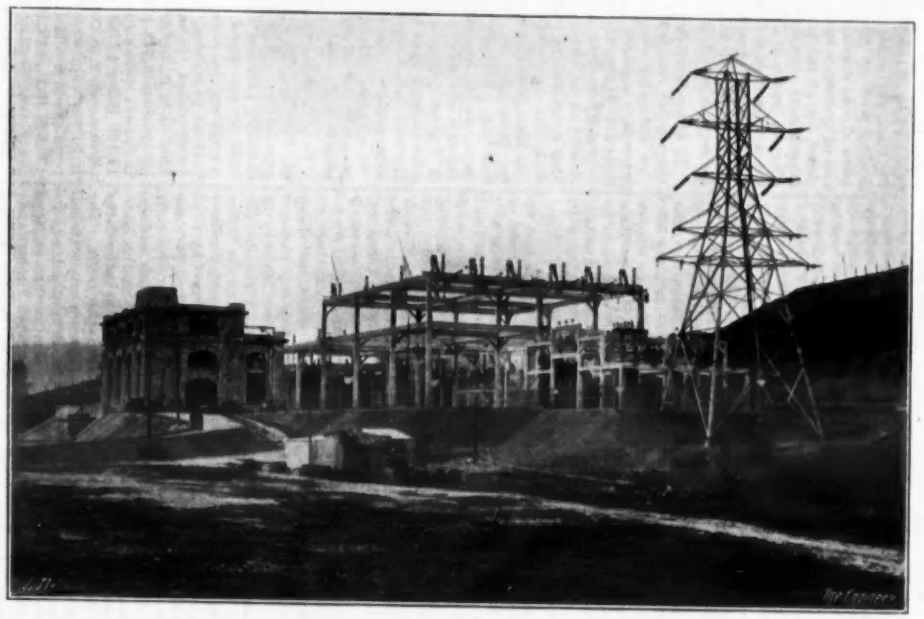


FIG. 43—POWER HOUSE, OUTDOOR SUB-STATIONS AND TRANSMISSION LINE TOWER

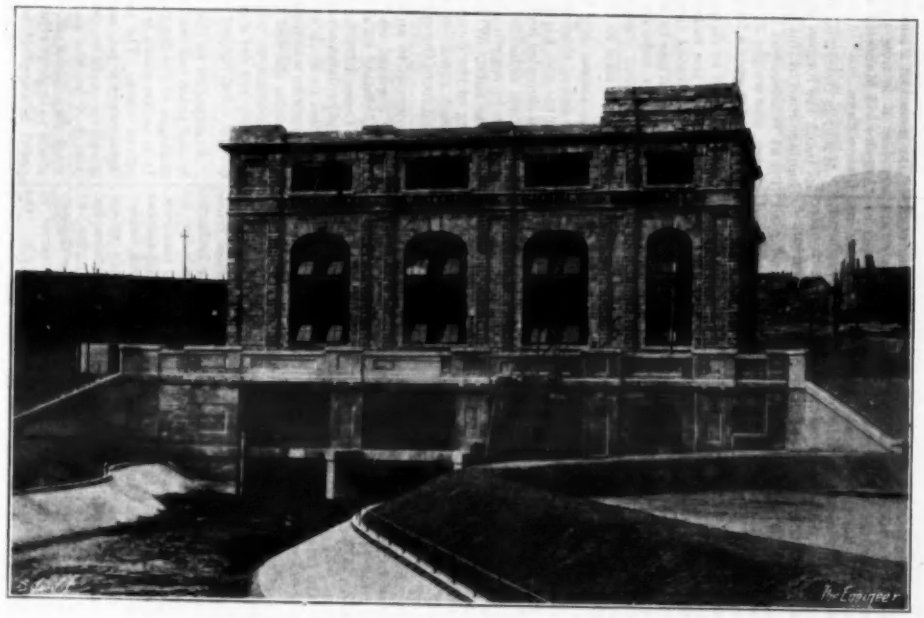


FIG. 44—FRONT VIEW OF POWER HOUSE

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THE ENGINEER.

VOL. CLII. No. 3947

SEPTEMBER 4, 1931.

National Economy.

THE National Government is now complete. Behind the closed doors of "No. 10" it is maturing the plans by which it hopes to save the credit of the United Kingdom. The country will await with very proper anxiety the revelation in the House of Commons, on Tuesday next, of the means and methods which the Cabinet proposes to adopt in order to avert the crisis with which it is threatened. It knows that the "balancing of the Budget" is the keynote of the task with which Ministers are faced, and it knows that the reduction of State expenditure will form one section of the scheme. With the exception of the Executive Council of the Trades Union Congress the country as a whole has expressed its readiness to support the Government in its efforts to save money, and the chief anxiety will turn upon the attitude which Labour—under the direction of the T.U.C.—adopts. It has been told that there is no "crisis," or that if there is one, it has been manufactured by the banks for their own purposes. It is being encouraged to resist the 10 per cent. reduction of out-of-work benefit and the increase of the workers' contribution to the now bankrupt insurance fund. Not until Parliament reassembles shall we know what power it possesses to make a successful resistance to this very necessary economy. The Government's majority cannot be large, and if it is defeated in its own efforts to reduce expenditure, the whole burden of balancing the Budget must, of necessity, fall upon the shoulders of the taxpayers, and those who consume exciseable goods. If that should happen, the industrial recuperation of the kingdom must inevitably be delayed. Increased taxation has a direct and immediate repercussion on industry, and excessively heavy duties on consumable commodities, such as alcohol, tobacco and tea, defeat their own ends. It is not so much by seeking to draw more money from an already impoverished community as by the exercise of strict economy that the dual object of avoiding a financial crash and restoring industry can be achieved.

Whatever is done, it is inevitable that sacrifices will have to be made by all, not only by the highest, but by the lowest. But they must be of a kind that will help industry to recover its position, for whatever steps may be taken now to avert the crisis will fail to prevent the recurrence of the same condition, at no remote time, if the trade of the country does not recover. We are in the position of a bank upon which there has been a "run," and which has been forced to save itself, first, by borrowing from other banks—as we have done from France and America—and, secondly, by making sacrifices. In the end those two courses must prove fatal unless they result in the recovery of business. That, we take it, is the object upon which the eye of every industrialist in the country will be centred. To most of them the mysterious movements of "money" are well nigh incomprehensible, but to all of them it is clear that whatever the strange performances of high finance may be, the restoration of their own prosperity is the first essential to the re-establishment of a sound financial position. The crisis would never have occurred had trade not declined; the fear of its recurrence can only be removed by the revival of trade. Emergency measures may, at a moment like the present, be imperative, but they must be so directed that they do not fall upon industry. It is no use cutting out the masts of the ship to save the hull if the vessel is drifting on to a lee shore. Over and over again it has been shown that this country is more heavily taxed than any other country, and it is well known that heavy taxation adds to the cost of manufactures and reduces the ability to compete with other countries. If, then, still further imposts are laid upon manufactures, our foreign trade will inevitably suffer still more, and the depression will increase instead of dispersing. Fortunately, the National Cabinet is not overweighted by Socialists and Communists. It is not likely to make any proposals aimed directly at the destruction of capital, and we anticipate, we hope rightly, that it will concern itself rather with the means of reducing expenditure than with devices—though some are inevitable—for raising more money. Economy, not taxation, is the solution to which we must look. It must begin with the Government, but it must be pursued also by the industrialists themselves, and by the householder. The whole country has lived since the war up to a standard which cannot be maintained in the present circumstances. It must courageously face the fact that it has diminished the actual value of the pound sterling by its extravagance, and that the only way to restore it is to be less liberal in its expenditure.

It has been said, and we are in full agreement, that what is now required is an intensive economy campaign throughout the country and through every grade of society. Its purpose should be to demonstrate that the fall in the standard of living can be reduced to small proportions if a greater value in goods and services is exacted for the pound sterling. For example, a general fall in wages would not result in the starvation of the working man and his family, for the cost of all that they consume would diminish as the wages fell. Rents on existing buildings would remain high because the cost of building has been excessive, but even they could be reduced without injustice to the landlord if the cost of upkeep and repairs fell. What applies to the working man applies also to the professional man. He would be content with lower fees if he could obtain for less money nearly all that he now has. The investor would be in the same position. His dividends might diminish, but as the purchasing value of the pound had appreciated, he would not be much worse off than before. Thus, the country might be returned to its old financial position and at the same time a greater power of competing with other countries be restored to industry, and unemployment be reduced. For some years economy has been deprecated on the ground that the more one pays the more there is to spend and the greater the general prosperity. We are now beginning to see that there is a fallacy in that argument—even in America. It leads to excessive remuneration for services rendered and to a reckless indifference to the value of money. The time has now arrived when, perforce, we must purge ourselves of that error.

The Progress of Illumination.

IT is an unquestionable fact that our ancestors were content with very much less light than we find necessary for our convenience and pleasures. Even as recently as a hundred years ago the use of effective oil lamps in the house was exceptional, and the candle was the recognised source of artificial

indoor illumination. There are many engineers alive at this day who remember that when they served their time the "half-penny" dip was a common object in the workshop, and frequently the only light available after dark. They will recall how they stuck it to a crude "stick" formed roughly from a piece of wood, or mounted it in a lump of its own grease at some convenient point on the slide rest, the bench, or the "work" upon which they were engaged. Even by day the intensity of illumination was far less than is now deemed merely adequate. One has only to observe the smallness of the windows in ancient houses, or to recall the gloominess of the foundry, the smith shop, and even the fitting shop in engineering factories, to appreciate the difference in this respect between the present and the past. Street lighting advanced a little ahead of domestic lighting, probably because bad illumination was the colleague and servant of the footpad and the cutthroat. Only a century and a half ago the Mayor and Aldermen of the City stated in a petition to the King that the streets were so badly lighted and watched and so infested with highwaymen that it was dangerous for citizens to venture out after dark. Not till the beginning of the nineteenth century was gas introduced for street lighting, and many years elapsed before it was commonly used in houses; the jubilee of electric lighting has barely passed.

In this week when an International Illumination Congress is being held in London and great demonstrations of the progress of lighting are being made by the dramatic use of flood-lighting on notable buildings, it is not unnatural to ask why such a great change has taken place. Why, for example, must we at this moment be writing with an electric lamp of some twenty candle-power pouring its rays upon the paper, when Charles Lamb, a few hundred yards away, and in our grandfathers' time, would have been satisfied with one or at most two candles? Or why must we have large type and lots of lumens when our grandfathers and grandmothers could read Johnson and "Mr. Spectator" in "nonpareil" or even "diamond" by a burning rush or the doubtful light of a sea-coal fire? Have our eyes changed? Have they lost some of their ancient acuity? Have we sacrificed, by our love of light, a little more of the animal power of "seeing in the dark" or are we living in a grossly over-illuminated age because lighting is cheap and is forced upon us, like patent medicines, by persistent advertisement? Is the intensity of light in which we live a real necessity, or is it a luxury, a form of sensory excitement equivalent to syncopated music, and as injurious to our nervous systems as noise? Or, looked at from the other side, has not illumination, intense by comparison with that of the past, become necessitated by our occupations? There can be no manner of doubt that output and accuracy in the factory are affected by the degree of lighting, and it is not impossible—nay, it is certain—that the amount of light which sufficed in the days of Watt and Stephenson, and even much later, when measurements were made by caliper and the "thickness of a worn sixpence" was accounted a good fit, would be hopelessly inadequate in the modern engineer's shop working to "thous" and passing products to "go and not go" gauges. We see in every work of the engineer's hands how all the advances cling together and are turned to one purpose. May it not be claimed that the illuminating engineer has contributed in no small degree to the accuracy of present products, as he has certainly done to the health of workers and the speed of work? We think of the astounding outputs of mass production factories as the immediate result of the labours of the mechanician and the organiser, and we forget sometimes that without the ability to use fine machines which has been given by the progress of illumination, their advent would have been retarded and their hours of use restricted. If sometimes we use artificial light extravagantly and from the mere pleasure that we derive from it, yet we must remember that without the plentiful supply of it which has been given to us by the gas engineer and the electrician, many branches of industry would be seriously hampered, and the enjoyment of those amenities which we call progress be delayed.

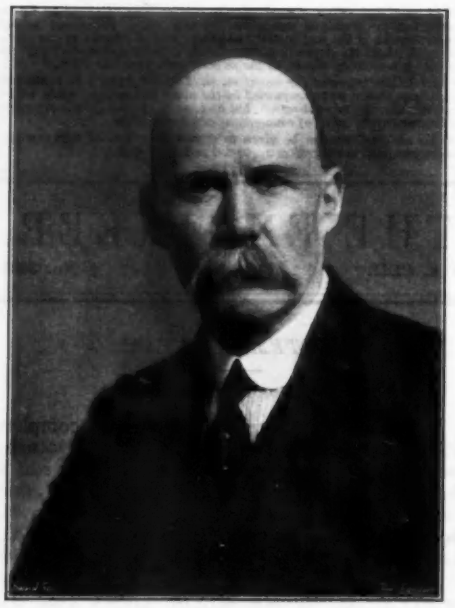
It is from this aspect that we should look upon artificial lighting in this week of the Illumination Congress. Like all good things, light may be misused at times, but nevertheless it must be agreed that amongst the greatest events of the past fifty years the coming of the electric lamp and the improvement of gaslighting will always stand out as two things which have conferred upon humanity blessings with so few drawbacks that, unlike nearly all other advances, they may be described as unadulterated. Mechanisation has done a deal to destroy the peacefulness and beauty of the world. Against it people rail daily; but against the gift of light no voice is raised in protest.

Obituary.

SIR THOMAS STANTON.

SIR THOMAS STANTON, F.R.S., who was drowned in the sea near Pevensey on August 30th, was a son of Thomas Stanton, of Atherston, and was born in December, 1865. He had secured a world-wide reputation as a scientific investigator and researcher, and in the domain of aerodynamics had no superior. He received his scientific education in Owens College, Manchester, and between the years 1891 and 1896 was a demonstrator in the Whitworth Laboratory of that College. He then went to University College, Liverpool, as senior lecturer in engineering, but in 1899 accepted the professorship of Civil and Mechanical Engineering at University College, Bristol. There he remained until 1901, when he was appointed Superintendent of the Engineering Department of the National Physical Laboratory. In December, 1930, he retired from that position and undertook private practice, the pursuit of which was interfered with in recent months by illness.

He was possessed of a very kindly but retiring disposition, and preferred the quiet pursuit of knowledge to the excitement and anxieties of industry. Thus, the history of his life resolves itself into an



SIR THOMAS STANTON, F.R.S.

uneventful record of the admirable work which he did during nearly thirty years at Teddington. The department over which he was called to preside was housed at that time in the stables of old Bushy House, and the organisation of an establishment, now employing a staff of nearly eighty persons and enjoying a world-wide reputation for originality of thought and accuracy of practice, was due to him. At an early stage in modern aeronautics he recognised the need for precise study of aerodynamics and he initiated and developed research in that subject in his laboratories until 1917, when the work had reached such dimensions that the establishment of an independent department became imperative.

So varied were the investigations upon which Sir Thomas's department and he himself were engaged, that we should cover a great part of the field of mechanical engineering in an effort to review them. But with one or two subjects he was particularly identified, amongst them "Friction," upon which he wrote a well-known book, and its kindred subject lubrication. He also carried out numerous experiments upon the wind stresses on buildings, and upon the fatigue failure of materials. In recent years he undertook a research upon the flow of air moving with two or three times the velocity of sound. On these and many other subjects he wrote papers which were presented to the Royal Society, the engineering institutions, and the Press. As recently as May last he delivered the James Forrest Lecture at the Institution of Civil Engineers, taking as his subject "Engineering Research." He was elected a fellow of the Royal Society in 1914, and sat upon the Council for the years 1927–29. For a couple of years he served upon the Council of the Institution of Mechanical Engineers, but the work did not appeal to him, and he did not seek re-election. He was called upon many other committees, notably those of the British Engineering Standards Association, to whom his wide knowledge proved invaluable; the Boards and Committees of the Department of Scientific and Industrial Research, and of the War Office; the Ministry of Transport and the Aeronautical Research Committee. He was awarded the C.B.E. in 1920, and in 1928 was made a Knight.

In spite of the many interests in which he was engaged, the fact remains that it is as one of the Superintendents of the National Physical Laboratory that his name will be remembered, and it was in that sphere that his best work was done. But in such a place and with a large staff acting under his direction, his usefulness did not end with his own labours. He was a source of inspiration and help to all who worked with him and thereby led to the success of researches actually carried out by others. Whilst much of the work that he conducted was of a precise nature, the hand of the veritable engineer was evident in all that he did and all the mechanism he employed. It is, in part, for that reason that engineers had every confidence in his methods and listened with particular attention to his opinions. He thought as they thought, and was one with themselves, and it is as much amongst engineers as amongst scientists that his unhappy death will be deplored.

STAFFORD RANSOME.

MR. STAFFORD RANSOME, who died suddenly on August 26th, was a member of a family of engineers and a son of Mr. Allen Ransome, who founded, in Battersea, an engineering business which gave particular attention to the construction of woodworking machinery. Many years ago the firm transferred its plant to Newark to avoid the heavy rating of London property, and to this day has remained amongst the best-known companies engaged in its particular class of engineering.

Stafford Ransome, with his two brothers, was brought up in the business, but he never took very kindly to factory routine, and about 1880 became a journalist, being at that time twenty years of age. In 1892 he was given a commission by the once celebrated *Globe* to visit Brazil, and from that time onwards his journalistic work was devoted principally to the development of commerce between Great Britain and oversea countries. Between 1896 and 1898 he was special correspondent for the *Morning Post* in the Far East, and in 1901 made an extensive tour in the East for the *Sphere* and the *Daily Express*. In 1902 he was sent to South Africa by THE ENGINEER and the *Pall Mall Gazette*, and wrote for our columns a notable series of articles entitled *South Africa from an Engineer's Point of View*. Coming so soon after the conclusion of the South African War, the articles proved of great value to British engineers, as they indicated the direction which efforts to increase trade should take. As a result of this visit he established and for several years edited a paper called *African Engineering*. In 1909 he again accepted a foreign commission from this paper, and wrote a series of articles entitled *Progress of Engineering in South and Central America*. It was followed in 1913 by yet another commission from THE ENGINEER—this time to the East, which resulted in a number of articles under the heading *Progress of Engineering in the East*, which ran intermittently through our volumes Nos. 115 and 116.

Shortly before this trip was made he had founded the British Engineers' Association, of which he was the director until 1917. The original purpose of that Association was the encouragement of British trade in China, and although for many years a wider view of its duties has been taken, the credit of forming the Association belongs to Mr. Stafford Ransome. We may also recall that he founded and edited *Eastern Engineering*.

Stafford Ransome had the versatility of the free-lance journalist, and although his early training in engineering and commerce affected the bulk of his work, he turned his hand successfully to other kinds of literature—two humorous political skits—"Clara in Blunderland" and "Lost in Blunderland," which appeared in 1902 and 1903—were partly written and wholly illustrated by him, and "The Nonsense Blue Book" of 1899—in the manner of Lear—was from his pen. But he wrote, also, more serious works, one on *Modern Labour*, 1893; another entitled *Japan in Transition*, 1899; *Practical Lessons of the War*, 1916; *Modern Woodworking Machinery*, 1924; and *Cutters and Cutter Blocks*, 1927. He was to the end recognised as an authority on woodworking machinery and was responsible, in part at least, for the organisation of the exhibit of woodworking machinery at the Buenos Aires Exhibition.

Literature.

Faraday. London: The British Electrical and Allied Manufacturers' Association. 1931.

A FORENOTE tells us that "this study of the life and work of Michael Faraday is published by the British Electrical and Allied Manufacturers' Association (Inc.), 36, Kingsway, London, W.C. 2, during the centenary year of the discovery of electro-magnetic induction."

The reader will seek in vain for any indication of authorship, unless his eye should chance to light on the fly-leaf at the end, where he will read, in quite small print: "This book was written by E. W. Ashcroft." Exceedingly well has Mr. Ashcroft done his work! By reading the volume, one is enabled to form a most comprehensive idea of the character and achievements, the abilities and disabilities of one of the most extraordinary philosophic investigators and experimentalists that this country—if not the world—has ever produced. The student of it will, too, learn a great deal about other scientists; but that is incidental.

At the outset we are told that Michael was the son of James Faraday, a blacksmith, who in 1787 came to work in London, where four years later, on September 22nd, 1791, Michael—his third child—was born. We are told how that in 1804 the lad was apprenticed to a bookseller, after receiving, as the sum total of his education, a certain amount of instruction in reading, writing, and arithmetic; and how that, on the expiration of his apprenticeship, he went to work as a journeyman bookbinder for a Mr. De La Roche, a French emigrant. We are told, too, of how the young man—with a full idea of the position he hoped to fill in the future—was continuously endeavouring to improve his education, his draughtsmanship, and his elocution; of his attendances at the lectures of Sir Humphry Davy and others; and of how he applied to Sir Humphry for, and actually obtained, when he was not quite twenty-two years of age, employment as assistant in the laboratory of the Royal Institution, where he was to spend the whole of the remainder of a brilliant life.

That, in broad outline, is the first portion of the life story of the great scientist, as told in the first few chapters of the book, but it gives no hint of the manner of the telling nor of the charm of the language used. To convey some idea of it, we may perhaps be permitted to give a somewhat lengthy quotation from an early part of the volume, for it shows, in far better words than we can choose, not only the nature of Faraday himself, but the spirit in which the biographer has carried out his work. The point of time referred to in the abstract was just when the young man had been given a post at the Royal Institution. We read:—

"The first wave of good fortune has carried him a long way. Not without reason was the early life of Michael Faraday held up as a moral lesson to children! How he spared no pains to write and speak correctly! How the blacksmith's son taught himself to draw in perspective that not a detail might be lacking in his equipment as a philosopher! How he earned the respect and love of his master, Riebau, by his application, and how well he was consequently rewarded! And it is undeniable that his early life, and, indeed, all his life is exemplary. But it bears witness to something much more than the power of hard work and determination. There is something inevitable behind the progress of the young bookbinder who became Davy's assistant. And by inevitable one means that the deep-centred enthusiasm, the clarity and precision of his mind, and the force of its longings are also behind the successful march of his life. The successful working of a strong character does not itself explain even his entry into the laboratory of the Royal Institution."

The author does not confine himself strictly to chronological sequence, nor does he use any great amount of technicality. The non-technical will read the volume with as great ease and pleasure as will the most erudite of technicians. The chapters that follow those to which we have drawn attention deal successively with the Royal Institution; Sir Humphry Davy; Faraday's prolonged, and not always too enjoyable, wanderings on the Continent with Sir H. and Lady Davy; the return to the Royal Institution; and Faraday's marriage; while the remainder—forming perhaps half the whole book—is devoted more or less entirely to the experiments of Faraday and others in connection with electricity, magnetism, and other matters.

We learn much regarding the many-sided character of the man; of his strong points and his weak points; his filial and brotherly affection; his delight in correspondence by letter; his philanthropy; his industry and his perseverence right to the end; and then the failure of his health. In fact, we gather concerning him an enormous amount of information, much of it of a nature such as is by no means always found in notices of a similar kind. The author has so many sides from which to approach his subject; the gem has so many facets. But, as he remarks, there is no key to Faraday's life; no isolated grouping of thought and action in the form of a conflict to drive him to work for relief from that conflict. "Everything in his life—his birth, his religion, his marriage—appear as expressions of a great and simple nature. The reason why Faraday as an old man retained the fresh enthusiasm, the simplicity and kindness of his youth, was because, in the midst of every kind of intellectual and social triumph, his nature did not change nor acquire qualities or defects alien to it. And in the crowning expression of his life, the discovery of the fundamental laws of electro-magnetism, the experimental philosopher is inseparable from the visionary. He had no need to turn his mind into a passionless instrument; he perceived the human elements of imagination and intuition in the laws and phenomena he investigated."

It is a charmingly written book, which will well repay careful perusal.

The Principles and Practice of Geophysical Prospecting. Edited by EDGE and LABY. London, 1931. Cambridge University Press. 15s.

ALTHOUGH much has been written descriptive of both the theory and practice of geophysical surveying—we ourselves recently published a series of articles upon the subject—most of the knowledge so far gathered of its applications and uses is locked up in the not easily accessible form of "Proceedings" of institutions and societies, and the files of periodicals. The number of books dealing with such surveys is limited, and many of them—if not most of them—are written in foreign tongues. The student is, therefore, confronted with the task of gathering together at considerable labour and expense the journals and "Proceedings" of societies, the papers published in which, owing to their nature, tend normally to deal with only one aspect or one detail of the subject.

The recent publication, therefore, of the report of the Imperial Geophysical Experimental Survey in Australia, under the title of "The Principles and Practice of Geophysical Prospecting," will be welcomed by mining engineers, civil engineers, geologists and geophysicists alike. We have noted before that, in the minds of many, geophysics is regarded as a subject not only of doubtful value, but one for which scientific support is meagre or entirely lacking. Particularly is this the case, as the director of the I.G.E.S., Mr. A. Broughton Edge, points out in a preface to the report, with regard to the electrical methods of survey, information about which has hitherto been lacking. In consequence, a larger proportion of the pages of the book is given up to such surveys than would have been warranted by their importance if a considerable bibliography upon them already existed.

Although the book sets out the report of the activities of a party sent out to Australia to test experimentally the value of geophysical surveying, its matter is not confined to descriptions of the methods used, nor to a dull recital of the results achieved. It is divided into two parts, each of which is again subdivided under the headings: electrical, gravimetric, magnetic and seismic. In the first part general non-mathematical descriptions of the principles involved and the field procedure adopted for each type of survey are followed by details of the investigations undertaken and the results achieved; while the second part is devoted to more detailed descriptions and mathematical expositions of the theory of the subject, together with observations upon the interpretations of the results. Much of the information included upon electrical instruments has never before been published. The "Survey" has not hesitated to publish maps and as many details as possible of the districts covered by its activities and of the results of the surveys carried out. The reader is, therefore, at liberty to draw his own conclusions as to the value of the various methods of survey employed if he does not wish to follow the reasonings of the members of the Survey itself.

The work of the Survey from its inception in London in February, 1928, until the close of its activities in Australia two years later is covered by the book. About eighteen months were actually spent in that country, and tests were made of most of the present-day methods of geophysical surveying. Arrangements were made to have trial shafts driven at places pointed out by the Survey to confirm or refute the indications given by the geophysical instruments. Included in the book are valuable conclusions drawn from the work of the I.G.E.S. as to the methods of survey best suited to various types of country, the costs of surveying by each method and many other details. If it were merely a description of a series of unbiassed tests of the claims made for various geophysical instruments and methods the book would be of considerable value, but covering as it does so wide a field of theory as well as practice, its value is still further enhanced. It is a text-book as well as a report.

SHORT NOTICES.

Electric Clocks. By F. Hope Jones. London: N.A.G. Press. Price 12s. 6d.—No one is better qualified to write on electric clocks than Mr. Hope Jones, who in this book of over 250 pages provides much interesting information on the subject. In a foreword written by Sir Frank Dyson, the Astronomer-Royal, it is explained that the book is the only one that covers the whole field. The historical information given in the first chapter of the volume shows that Alexander Bain, a mechanic associated with Sir Charles Wheatstone, was the first to invent an electric clock, and that he took out a patent in October of 1840. Since that time there have been 800 published patents on the subject of electric clocks, without counting those which never got beyond the stage of provisional application. Not more than 10 per cent. of these inventions has ever been heard of again, and the author assumes that the difficulties of manufacturing and marketing have proved too great for the enthusiasm and ability of the inventor to overcome or, alternatively, their lack of originality and merits have been sufficient to account for their oblivion. Mr. Hope Jones devotes several chapters to the Shortt clocks, which are now in use in various observatories, and in commenting on these chapters Sir Frank Dyson remarks that experience at Greenwich has shown that it is not an unreasonable hope that the regularity of the rotation of the earth may eventually be checked by electrically operated clocks. As we have indicated, the book covers the whole field; it is liberally illustrated and is written on simple lines.

BOOKS RECEIVED.

The Advertiser's A.B.C., 1931. London: T. B. Browne, Ltd., 163, Queen Victoria-street, E.C. 4. Price 21s. net.

The Motor Manual. Twenty-eighth edition. London: The Temple Press, Ltd., 5–15, Rosebery-avenue, E.C. 1. Price 2s. 6d. net.

Markets for Internal Combustion Engines. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

A Manual of Rigging for Aircraft, 1931. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 4s. 6d. net.

Tacheometric Tables. By F. A. Redmond, B.Sc., &c. London: Crosby Lockwood and Son, Stationers' Hall court, E.C. 4. Price 8s. 6d. net.

Principles and Problems of Aircraft Engines. By M. M. Farleigh. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 15s. net.

Petroleum Refinery Statistics, 1929. By G. R. Hopkins. Washington, D.C.: Superintendent of Documents, Government Printing Office, U.S.A. Price 30 cents.

Ninth Annual Report of the Safety in Mines Research Board, 1930. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Causes and Cures of Unemployment. By Sir W. H. Beveridge, K.C.B. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 2s. 6d. net.

Economic Conditions in Chile, 1930. Report by E. Murray Harvey, O.B.E., M.C. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

The Problem of Fluctuating Loads on Boilers. By G. E. Hider, A.M. Inst. C.E., M.I. Mech. E. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 7s. 6d. net.

Economics for Engineers. By E. L. Bowers, Ph.D., and R. H. Rowntree, M.B.A. London: McGraw Hill Publishing Company, Ltd., Aldwych House, Aldwych, W.C. 2. Price 20s. net.

The Main Line Railways of Great Britain, 1923–1930: *A Study by the Railway Research Service, Based on Official Figures.* London: The International Union of Railways, 4, Cowley-street, S.W. 1.

The Ignition of Fire-damp by Coal-mining Explosives. I.: *Gallery Experiments.* By H. C. Grimshaw and W. Payman. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 6d. net.

Materials of Construction: Their Manufacture and Properties. By the late Professor A. P. Mills. Fourth edition. Edited by H. W. Hayward. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 20s. net.

THE MODEL ENGINEER EXHIBITION.

MODEL-MAKING is a most fascinating occupation, and that fascination is well exemplified in the Model Engineer Exhibition, which was opened by Sir Felix Pole in the Royal Horticultural Hall, in Westminster, yesterday. Its run is for only ten days. It is one of those displays, possibly the only one, that gives scope to the inventiveness of our budding engineers, and by the reception of their ideas must give encouragement to those who are not in a position to finance their schemes on commercial lines.

Every engineer worthy of the name has passed through the inventive stage, and many have failed to reap the benefit of their ideas for lack of appreciation; but here is an opportunity for their display. For Mr. Percival Marshall, the organiser of the Exhibition, enjoys nothing more than something that is quite novel, whether it may be made in the most precise methods of the mechanical workshop or "put together" on the kitchen table.

This year, and it is the thirteenth anniversary of the Exhibition, the Hall is as fully occupied as usual, but it is noteworthy that the amateur contingent is in the ascendency, and that mere toys do not seem to be in such great demand. In fact, the modern lad, and it is on his efforts that the future depends, is not content to buy a "toy" ready made. He obviously wants to have some hand in its making and designing.

At the Exhibition he has an opportunity of seeing some of the appliances that are used in making models, such as lathes, shapers—including an ingenious form of hand-worked machine with a toothed sector drive—drills, and hand tools; but, above all, he has the examples of other's industry and inventiveness to encourage him to emulation or improvement.

As to the actual exhibits, we will not enlarge upon them here, but would like to impress the fact that, although the name "Model" in this connection is very generally accepted as implying juvenile, there is much of direct interest to the practising engineer in the Exhibition.

IN view of the proposal to construct a ship canal at Nicaragua, the United States Navy is making an extensive series of soundings in Bartlett Deep in the Caribbean Sea, between the Bay of Honduras and Guantanamo. The Deep is known to have depths as great as 4 miles and is thought possibly to represent a fault that might endanger the canal through earthquake shock. Two destroyers equipped with sonic depth recorders are being used in the survey.

Variable Speed Friction Gear.

WE recently inspected at the works of Diskon Gear, Ltd., of 64, Victoria-street, London, S.W. 1, a new type of variable-speed gear which has been constructed under the patents of Dr. Hele-Shaw, F.R.S., and Mr. T. E. Beacham, B.Sc., and has undergone continuous tests during the past two years, during which period it has been employed with a motor driving the company's works. Several examples of the new reversible type gear are to be exhibited in operation by the company at the forthcoming Shipping, Engineering and Machinery Exhibition at Olympia.

More than one attempt has been made to produce a reliable and satisfactory form of infinitely variable and reversible gear of the disc and roller type, and that form of friction drive has in the past been applied with varying degrees of success for certain purposes. The present gear is, however, to be distinguished from its predecessors, first in respect to the degree of hardness and elasticity of the disc and roller surfaces, which has been rendered possible by the newer alloy steels and improved hardening methods; secondly, in the employment of ball and roller bearings in all important wearing parts; and, thirdly, by the use of an ingenious mechanical method for changing the point of contact of the roller with the disc and varying automatically the intensity of pressure between the surfaces according to the load the gear is desired to transmit. A further new feature is the use of a differential gear wheel arrangement between the two friction rollers, which avoids the necessity of carrying the driven friction roller across the centre of the disc in order to obtain at the output shaft any desired speed in either the forward or reverse direction, thereby providing when required a zero position without the use of a clutch.

The present development, Dr. Hele-Shaw informs us, is a direct continuation of his earlier studies and work on friction problems which he began in 1884, when his first paper was communicated to the Royal Society by Sir William Thomson (afterwards Lord Kelvin). After describing in this paper the use of sphere and roller mechanism in integrating machines, the author went on to show in what manner the same mechanism could be applied for power transmission purposes and deduced a power transmission gear of the sphere and roller type. A sack-lifting hoist embodying these principles was made by Dr. Hele-Shaw, and is at present to be seen in the South Kensington Science Museum. It gained for the inventor a Gold Medal award in the Royal International Inventions Exhibition of 1885.

Above we illustrate the 4 B.H.P. non-reversible unit direct coupled to an electric motor, which has been employed to drive the machinery in the company's works at 45, Horseferry-road, Westminster, during the past two years. We have personally operated this gear, and have moved the control lever with remarkable ease from one extreme position to the other—that is, from minimum to maximum speed—and we noted that the surface of the disc was in a remarkable smooth and highly polished state, exhibiting no apparent wear on the working surface. The assembly shown in Fig. 2 illustrates the unusually small degree of surface contact which is necessary in order to transmit several horse-power. It represents a model of the non-reversible type of gear with a single driven roller and its guiding supports. The yoke carrying the disc, through the arms of which the driven shaft passes when the gear is completely assembled, may be noted. In this particular design the roller is moved across the disc by means of an auxiliary shaft arranged on a three-point lever suspension, which by means of a simple hunting gear moves the roller and automatically applies the pressure appropriate to the load transmitted.

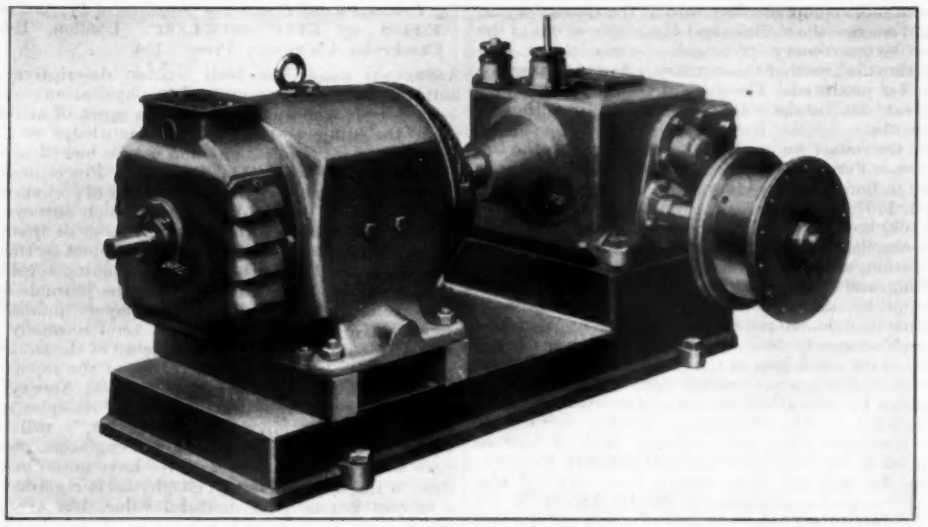
For the purpose of a detailed description of the "Diskon" infinitely variable speed reversible gear, we invite our readers' attention to the drawings reproduced in Figs. 1 and 3 and the accompanying velocity diagram. The diagrammatic drawing reproduced in Fig. 1 shows the reversible gear in the neutral, full speed forward, and full speed reverse positions; while in Fig. 3 sectional drawings of a typical 5 B.H.P. size of reversible "Diskon" gear designed for an input speed of 1500 r.p.m. and an output speed of from zero up to about 800 r.p.m. in either direction is given, along with a velocity diagram.

From these drawings it will be seen that a hardened steel disc on the input shaft drives two steel rollers which are maintained in contact with it by a force applied through a pressure roller. The position of this roller is so fixed that it is equi-distant from the two driven rollers, and therefore applies an equal pressure on each of them. The driven rollers are mounted on projections of the roller housing, and on the inner side of each there is formed a bevel gear which meshes with four pinions running on ball bearings which are carried in a cage, the complete assembly forming a differential gear. The cage is attached to the output shaft by means of a cardan shaft, having, as our illustration indicates, a universal joint at its inner end and a universal and sliding joint at its outer end. The driven rollers are mounted on heavy ball races, and the whole of the mechanism runs in an oil bath. As will be seen from the drawing, the roller housing itself is machined in such a manner that either right or left-hand driven shafts can be obtained. In Figs. 1 and 3 we show the gear in the neutral position, in which the disc drives the two rollers in opposite directions at equal speeds, under which conditions the differential cage and the output shaft remain stationary, the operating lever being in the neutral slot at the centre.

Let us now consider the diagrammatic drawings reproduced in Fig. 1. In the full-speed forward and the reverse positions it will be noted that the left or right-hand roller respectively is revolving at the outer edge of the disc, and is therefore turning at its maximum speed.

4 H.P. DISKON VARIABLE SPEED GEAR AND MOTOR

DISKON GEAR, LTD., LONDON, ENGINEERS



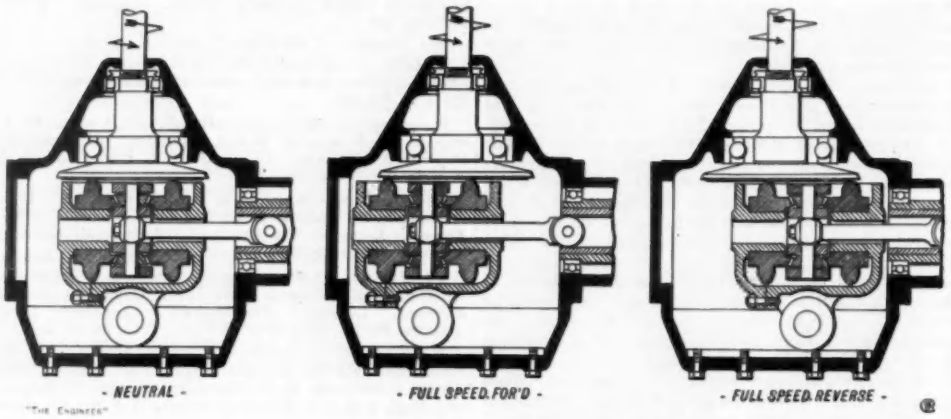


FIG. 1—DIAGRAM OF REVERSIBLE GEAR

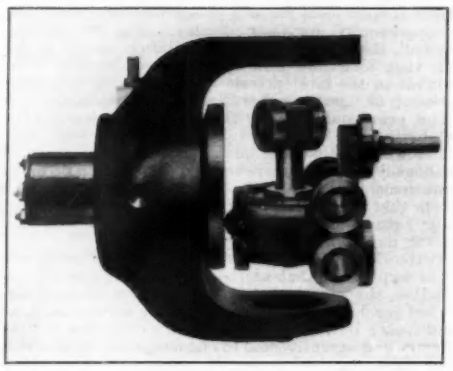


FIG. 2—DISC AND ROLLER ASSEMBLY

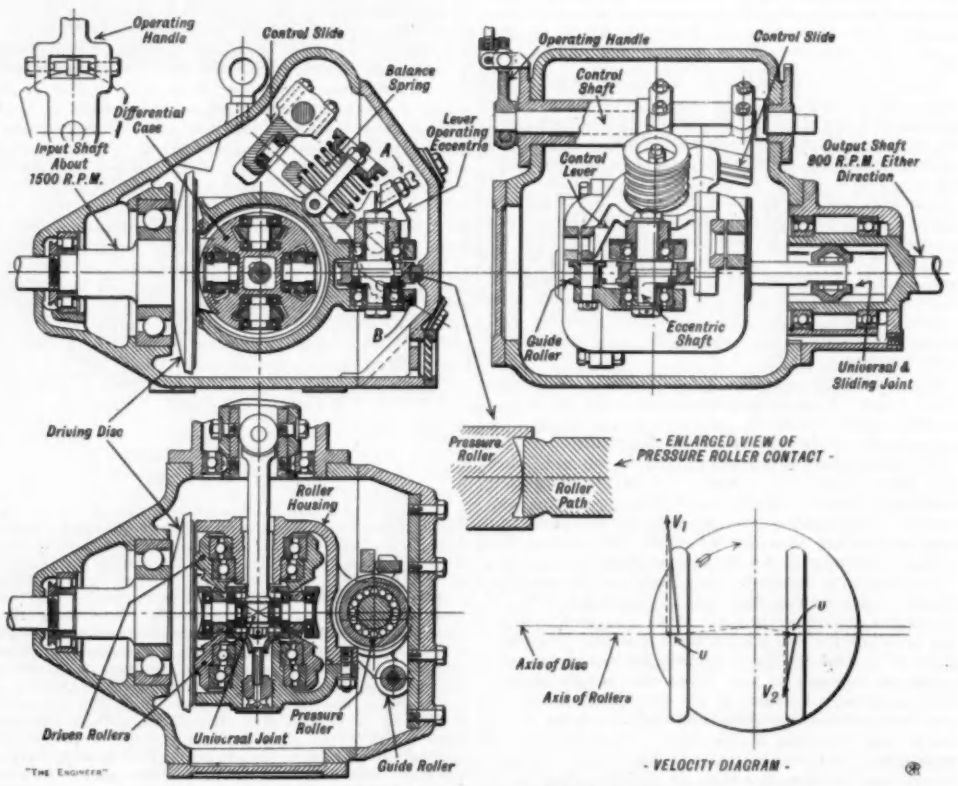


FIG. 3—5 B.H.P. REVERSIBLE "DISKON" GEAR

The inner roller, however, being on the opposite side of the centre to the outer roller and nearer the centre of the disc, turns in the opposite directions at a slower speed. The speed of the driven shaft, therefore, is that of the differential cage corresponding to the difference of the relative speeds of the two rollers.

The control of the positions of the rollers on the driving disc is obtained by moving the operating handle, which, as shown in the drawing Fig. 3, has a quadrant and an automatic notching attachment, and is fixed to the control shaft, which shaft in turn carries a crank operating the control slide. By advancing or drawing back the operating handle the control slide can be raised or lowered on a course inclined about 45 deg. to the horizontal axis of the gear. As shown in the view to the right of Fig. 3, the control slide carries an inclined slot, which engages with a small roller attached to the control lever. For the purpose of our present consideration let us assume that the control lever is rigidly attached to the roller housing; the actual arrangement will be referred to later. It will be seen that a movement of the operating lever raises or lowers the control slide, which, in turn, lifts or depresses the main roller housing. The housing itself rocks on the pressure roller, the point of contact between this roller and its path forming a fulcrum, the shape of which is indicated in the enlarged sketch, reproduced in Fig. 3. When the roller housing is lowered by the control lever so that the axis of the rollers falls below that of the disc, as shown in the velocity diagram reproduced to the right of Fig. 3, the velocity at the point of line contact of each roller must, for non-slip conditions, be at right angles to the disc radius. In this case the point of contact of the left-hand roller will have a velocity represented approximately by the vector V_1, while V_2 represents in a similar way the point of contact velocity of the right-hand roller. The vertical components of these two velocities will, of course, tend to rotate the rollers in opposite directions. It will be also seen that the components of the velocities parallel to the axis of the rollers will tend to move them bodily across the disc, while, moreover, these velocities are equal, both in sign and amount. This being so, the two rollers move as one, which, in fact, they must do to avoid slip, as they are both housed in a common casing.

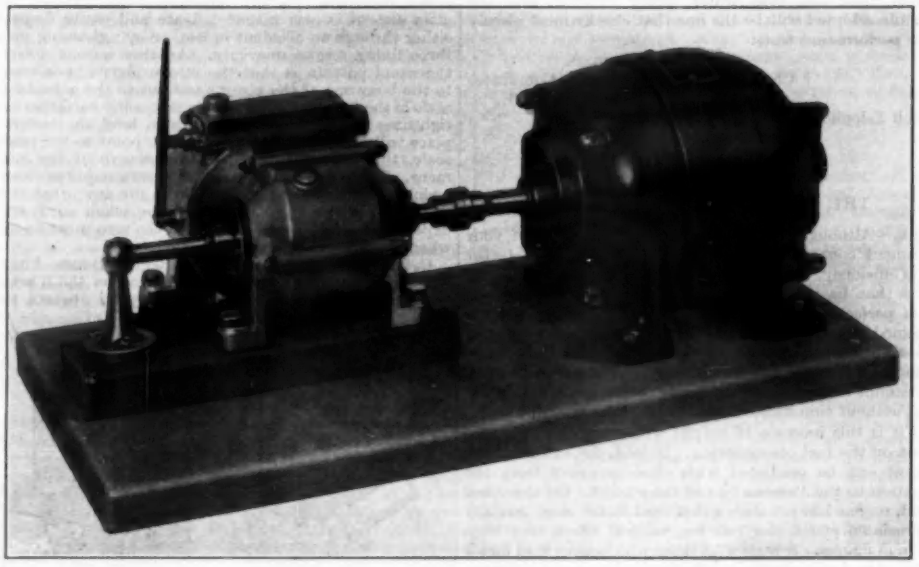


FIG. 4—THROUGH-DRIVE "DISKON" GEAR AND MOTOR

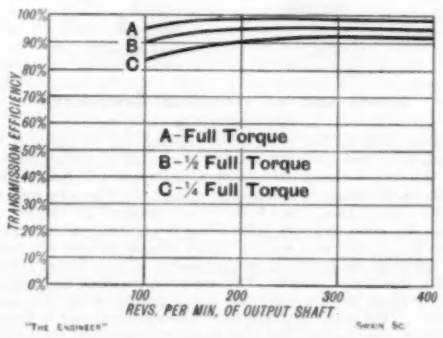


FIG. 5—EFFICIENCY CURVES

Referring now to the drawings of the gear reproduced in Fig. 3, it will be seen that the side movement of the rollers in the direction indicated in the velocity diagram will move the small roller carried on the control lever up the slot in that lever, thereby raising the common axis of the rollers in respect to the axis of the disc until the two axes are coincident and further side motion of the rollers ceases, the point then being reached at which equilibrium conditions are attained. Thus the mechanism we have referred to constitutes in itself a short of servo-motion, so that, when the operating handle is moved and the rollers raised or lowered an extremely small amount, the motion of the gear itself puts the rollers into the required position and automatically restores equilibrium. A further feature of the design is that the mechanism employed is such as to avoid entirely any side thrust on the rollers, the side movement of the roller housing being practically unrestrained.

We may now describe the manner in which the contact pressure is proportioned according to the load on the output shaft. Any resistance which may be applied to the motion of the output shaft will bring about a corresponding tangential reaction at the points of contact of the rollers with the disc. Such a force will have the effect of tending to move the roller housing in an upward or downward direction, according to the direction of motion of the output shaft, and such movement will be resisted by the small roller on the control lever. The control lever, instead of being fixed to the roller housing, as we have previously assumed, is actually hinged to it, and it acts on the lever operating the excentric upon which the pressure roller is mounted through one or other of the two adjustable screw stops, A and B, indicated in Fig. 3. Whether the reaction on the small roller be in the upward or downward direction, the control lever acts on the lever operating excentric in such a way as to increase the contact pressure so that this is maintained always proportional to the load. The tension spring provided on the gear counterbalances the weight of the hinged roller housing, so that the actual force acting between the control lever and the lever operating the excentric on which the pressure roller is mounted is not affected in any way by the weight of the actual gear parts.

In diagram Fig. 5 we show a typical set of efficiency curves for the Diskon gear which have been supplied by Dr. Hele-Shaw.

In both the two gears already described it will have been noted that the output shaft is arranged at right angles to the input drive. There are, however, in many instances particular cases in which a straight through drive may be required, and the inventors have designed a gear which meets this demand. In Fig. 4 we illustrate a small electrically driven model, showing a through drive "Diskon" gear. While this gear embodies the same general principles already referred to, instead of the disc being the driver and the two rollers the driven members, these parts are so arranged that one of the rollers becomes the driver and the other the follower, the output shaft being driven as before from the differential cage, thereby giving a straight line drive.

At the Shipping, Engineering and Machinery Exhibition, arrangements are being made to illustrate the various applications of the "Diskon" gear for machine tool drives, winches and hoists, and other varied uses.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAYS AND THE PUBLIC.

SIR,—The letter by your correspondent, "Debenture," page 193, August 21st, 1931, suggests the possibility of making "railway rolling stock lighter than road coaches."

Full working drawings, with details and specifications of weights and strengths, show that this is actually practicable, and with great attendant advantages; but it does not appear that such an improvement to arrest the rapid decline of railways is likely to be readily agreed to by the railway mechanical departments, to whose decision such matters are always referred. It may be recollected here that all the great improvements on railways came from outside individuals, such, for example, as automatic brakes, signalling, line equipments, improved locomotives, high pressures, compound expansion, superheaters, &c., and most frequently they were English inventions, whose prior use on foreign railways finally led to a lethargic adoption here.

Your correspondent's letter is, therefore, of suggestive value, and may lead to some action by shareholders who, through the competing petrol traffic on the public roads, are no longer receiving dividends.

Adopting the "super-luxury saloon road liner" coach, designed to run at 50 miles per hour, as the model for improved railway cars, these now seat 3½ times the number of passengers per ton of unladen weight that are carried in steel-tired railway vehicles, and when fully equipped for running in long trains on railways, three times that number, while non-motor "trailers," without place for a driver, but adapted for being run by tractor combinations on the public roads, carry four times that number, and thus exceed the capacity even of the road coaches. For a given number of passengers to be carried, this means, as he remarks: "Less wear and tear to permanent way, a reduction of noise, better acceleration and increased comfort."

A locomotive of the largest size which now hauls as a maximum 700 passengers, could transport 2000 persons at the same speed, while 700 passengers could be hauled at the highest speeds now admissible, by locomotives of the power usual about sixty years ago.

Such a trebling of the maximum daily transport capacity of the railways involves no increase in the weight of locomotives or in the (improved) rolling stock, in power or fuel expenditures, in train-crew labour, or in track and permanent way upkeep costs.

The car axle loads would be reduced from 10 tons to 3 tons, and the tire loads reduced in a still greater proportion.

The collective gains by this structural change in the vehicles employed appear to be about double those claimed in Weir's report for main line electrification at a cost of £400,000,000.

Concerning this latter scheme, one must bear in mind that an electromotive—and these machines would be at the cost of the railways in his scheme—costs 2½ times more than a locomotive prime mover, and that they cost, in £ s. d. for power at the train head 40 per cent. more than the cost of the energy supplied to them at the central station switchboard—that, is, over a third of the energy is lost before it reaches the train head. Then, this electrification means the use of the steel tires which the public is increasingly condemning as "old fashioned" and "obsolete." In financial straits, Germany has open-mindedly, for many years past, tried every form of power, as electric traction, Diesel motors with every known form of transmission—mechanical gears, hydraulic, oil-electric, and, best of all, compressed air. It has tried super-pressure locomotives, and, finally, after long experience of the ordinary compound locomotives in Bavaria, has at last standardised the medium-pressure compound locomotive as the best all-round tool for railway transport, whatever may be the final outcome of the compressed-air locomotive with Diesel compressor aboard.

The most urgent problem of the railways is now the petrol-vehicle competition on the public roads, for the popularity of the pneumatic-tired vehicle, for passengers and for goods, is ever increasing with the decline of the railways.

All our basic industries, as coal, iron, steel and heavy engineering, are suffering together in measure as imported petrols and crude oils displace older, native fuels and prime movers, and in dispensing with or disemploying labour on an unprecedented scale, and this, of course, leads to the closing down of works in co-lateral industries. In measure as the stagnation increases, makers of petrol motors advertise yet more new applications of them, guaranteed to disemploy so many more men at a given job.

Unpopular as railways now are with a public infatuated with motor coaches and motor joy-riding, they are still a great stay of our staple industries and merit more consideration from the public; but there appears to be no other way of drawing the public back again from the petrol traffic of the public roads to the railways than to convey them to the railways in the immensely popular motor road coach, and then to set them down in streets and roads in far distant places without any intermediate changing of seats, of wheels, of tires, or of the coach body. And goods, collected and packed in any street, might, by the same means, be delivered to some address two hundred miles away before passengers in "luxury road liners" could reach the same point by all-road transit. By carrying three passengers at the cost of one, as now, railways could undercut road traffic rates.

The gain to railways and to collieries, also to heavy engineering trades, and for the country's prosperity generally, would result from 80 to 90 per cent. of such transports being run on railways using coal and in leaving the balance to be operated by foreign petrol or crude oil on the public roads.

At present, road transport costs 2s. 6d. per 100 ton-miles for foreign petrol, and crude oil in Diesel motors costs 5d. to 6d. per 100 ton-miles, while smokeless Cardiff coal costs 1d. per 100 ton-miles with trains of 600–700 tons at 63 miles per hour.

For equal cost in fuels, the steam locomotive transports 300 ton-miles, the Diesel motor 50 to 60 ton-miles, and the petrol motor 10 ton-miles. (These figures are from published A.E.C. tests of heavy vehicles on public roads.)

One locomotive could haul sixty luxury saloon road liners 100 miles with a crew of six men-hours, while the same vehicles by road to the same point necessitate 180 men-hours, even without any conductors.

The use of road vehicles on railways requires trackways of rail height, usually steel channels filled to rail level with road paving blocks. These can be rapidly clipped on and firmly keyed to existing sleepers in forming a strong-framed trackway, more resistant to deformation, displacements and "creep" on curves, even without steel rails than an electrified line with four steel rails. These ribbon tracks can be rapidly slid off whenever needed, and do not interfere with any existing railway lay-outs or track equipments, or with the daily inspections by gangers.

The trackways support the lateral forces set up by trains

in rounding curves without need of any flanged wheels, for the wheels are guided, through the usual steering mechanism, by trolleys, fore and aft, whose rollers carry no weight, but run loosely between the inside faces of the rail head. A few turns of a screw, under the driver's hand, suit the vehicle for running alternately by road and by rail, and the dropping of the trolley between rails automatically makes the connection between this and the steering gear. The sharper the curve, the deeper the guide-runner is forced below the level of the outer rail, or precisely the opposite action that is usual with flanged wheels, the object in view being to prevent derailments from excess speeds, such as happened this year at Carlisle and at Leighton Buzzard. In addition, there are several devices tending to greater safety of vehicles both by rail and by road.

On the splendidly aligned railways, with their elastic ballast beds, the absence of vibrations and the improved, dead-smooth running, might result in a notable economy of tires and under gears comparatively to running on the bumpy surfaces of the rigid public roads.

The uses of these trackways apply also to contractors' service lines on new railways where motor road lorries and trucks are used for removing spoil before the steel rails can yet be laid on them, and for this temporary service the motor vehicle trackways are simply timber baulks plated on their inside edges. For military, field and strategic railways, the same temporary baulkways are to be used. The "ribbonway" tracks are designed for tipping runways over barges and other vessels; for elevated tipping runways over lines of goods trucks in sidings—for discharging lorry loads direct into railway vehicles; also for approach lines to train ferries that have been adapted for rail-running road vehicles; for ramps, or inclined ways, to upper stages or floors, and, in a very light modification of the system, for launching aeroplanes from sea vessels.

During mobilisation, for which every country is prepared, the facility to despatch treble the number of troops that are possible by the usual steel-tired vehicles, and, that, across country from railway to railway, is of great importance when railways might be destroyed in places by bombs, and when all electrified main lines would be paralysed by the reduction of their power stations to dust. An "electrified" country without steam locomotives—which the newspapers trust may be realised soon—would then be dependent on petrol and oil lorries, and these, in the national interest, should be adapted during peace times for running over the railways.

London, August 31st. CHARLES R. KING.

"DIESEL-ELECTRIC" RAILWAY TRACTION.

SIR,—The well-known connection of Captain Durtnall with the technical side of Diesel electric traction entitles his letter in your issue of August 28th to great respect, but may I venture to point out that the adoption or not of this form of transport on the railways of the world is dependent upon economic, and not upon technical questions? As examples of my point, the work done per month by an electric or Diesel-electric locomotive is such as completely to counterbalance any additional initial cost over a steam locomotive. Any losses in efficiency due to the medium of electricity as a transmission are made up not only by utilisation of full engine power continuously, but the possibility of shutting down the engine entirely on down grades, and thus saving fuel and wear. In any event, the 26 per cent. overall efficiency of oil to wheels compares favourably with the 8 per cent. from coal to wheels. Lastly, a 2 per cent. improvement in the efficiency of the heat cycle of a steam engine can do little to balance the cost of coal and wages which are wasted while a steam engine is idle.

Again, regarding regeneration of energy, Captain Durtnall points out that this is impossible with oil engine traction—though giving no indication as to how it might be effected in an improved steam locomotive—but it is only the railway's accountant who can say how much of the savings obtained on those electric systems employing regeneration is due to recuperated energy and how much is due only to reduced brake shoe, tire, and track maintenance brought about by the electric braking. It has been stated that it is this latter saving—easily obtainable on oil-electric locomotives—which has influenced many of the electric railways which have invested in regenerative equipment; and it is only the traffic managers who can estimate the probability of energy being required by an up train at the same time as a down train is on the gradient, even in those most favourable cases, viz., mineral railways near the coast where there is a preponderating balance of traffic in the down-gradient direction.

C. M. BECKETT.

London, S.W. 1, August 28th.

SHEAR STRESSES IN HELICAL SPRINGS.

SIR,—Mr. Adams, in his article on "Shear Stresses in Helical Springs," in your issue of June 26th, refers to Rover's work on "Stresses of Helical Springs in Circular Cross Section," published in 1913, and Mr. Wahl's paper on "Stresses in Heavy Closely Coiled Helical Springs," published in 1928. Mr. Adams has extended the work of these investigators and derived new formulæ which fit very closely with the experimental results published by Wahl. It is believed that Mr. Adams' contribution to this subject is a very important one, but it will require considerable experimental verification before it can be generally adopted.

Indeed, since the publication of Wahl's work there has been some surprise expressed at the rather high stresses that his formula indicate for helical springs. Using the old methods, springs have been computed and have been used in service for years without difficulty, and in some instances when recomputed by Wahl's methods, indicate stresses abnormally high, which should cause trouble in service. The work done by Messrs. Wahl and Adams has called attention to the need for considerable experimental verification of the theoretical work. A programme is now under way by the A.S.M.E. Special Research Committee on Mechanical Springs to determine the effect of various factors in the design of helical springs on the fatigue endurance of the regularly manufactured full-size railway bolster spring. A practical result of this investigation will be a definite evaluation of the work of Messrs. Wahl and Adams. The position of the designer at present is that this work is interesting, but is it really significant as far as practical engineering results are concerned? As a further result of this work, the Committee will definitely decide upon and standardise spring formulæ, and the formula adopted will be the one that checks most closely with performance tests.

J. R. TOWNSEND,
Chairman, Special Research Committee on Mechanical Springs, A.S.M.E.

Bell Telephone Laboratories, New York,
August 20th.

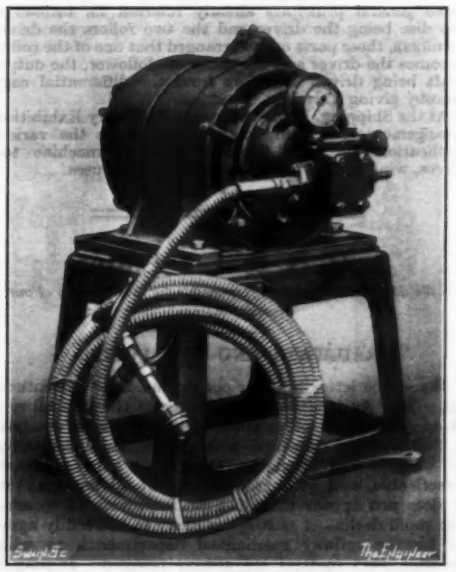
THE EFFICIENCY OF KEARSLEY.

SIR,—Although Mr. W. Ross admits the truth of your argument concerning the negligible effect of load factor upon efficiency, the second paragraph of his letter seems to show that he is, nevertheless, only partially convinced. It is perfectly true, as he says, that "for any station designed for and carrying a certain maximum load, the consumption per unit will be decreased as the load factor is increased," but this in no way affects the argument. He cannot increase the load factor with a given maximum load without simultaneously increasing the annual output, and it is this increase of output which has the beneficial effect on the fuel consumption. Indeed, the extent of the benefit can be predicted with close accuracy from the equation to the Parsons line of the station. On the other hand, no one has yet shown that load factor alone has any appreciable effect, nor has any alleged effect ever been given in figures. It rests with those who believe load factor to be of real importance to efficiency to show what change in fuel consumption would be observed in a given station if the load factor were varied between the limits of commercial practice, the annual output remaining unchanged.

August 29th. K. W. H.

A New Gear Pump.

By adapting the principles of gearing to suit the special requirements of gear pumps, David Brown and Sons, Ltd., of Huddersfield, have produced a very neat and compact type of pump capable of carrying out a number of duties. In the illustration that accompanies this article, a car-washing equipment is shown. The pump itself is fitted upon a bracket which is bolted directly



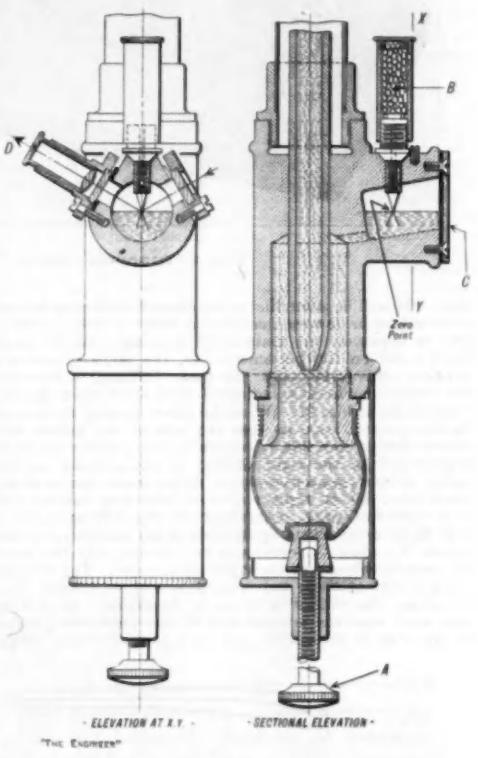
GEAR PUMP AND MOTOR

on to the casing of the motor. A length of flexible piping with a nozzle attached and a stool upon which the motor stands, complete the equipment. For the new range of pumps the makers have designed gears, of which the teeth are cut to a form patented under the name of "Roloid." By using this form of tooth undercutting is avoided, even when, as in this case, there are only eight teeth on each wheel. On a similar wheel using the involute form of tooth with a pressure angle of 20 deg., the teeth would be quite severely undercut, resulting in noisy operation and fluid losses. The makers claim that a marked increase in the discharge for a given size of pump follows upon the reduction of the number of teeth to eight. Care has also been taken in the design to eliminate the possibility of the trapping of the fluid between the teeth as they come into engagement. According to the makers, the volumetric efficiency of the pumps when used with lubricating oil, ranges between 90 and 95 per cent., the power efficiency being at the same time between 40 and 60 per cent., according to the delivery pressure and the viscosity of the oil.

An Improved Fortin Barometer.

ONE of the disadvantages inherent in the Fortin barometer is that the fiducial point is read through the curved surface of a cylindrical glass cistern. As these cisterns are made from a piece of drawn glass tubing, it is impossible to obtain a very clear view of the point and its reflection at the moment of contact, owing to the existence of striæ in the glass and to distortion of the image from the optically imperfect glass surfaces. The glass cistern is also rather delicate and easily damaged, either through an accident in use, or by tightening up the three fixing screws unevenly. Another serious defect in the usual pattern is that the measuring point is secured to the boxwood of the cistern and not to the actual metal scale of the barometer. In consequence, any variation in the tightness of the three screws which hold the cistern in place will alter the distance from the point to the reading scale, thus introducing errors in the zero of the instrument. When the mercury in the cistern requires cleaning owing to oxidation of the surface or for any other cause, the whole of the lower part has to be taken adrift by an expert and a new determination of the zero must be made when the instrument is reassembled.

C. F. Casella and Co., Ltd., of Regent House, Fitzroy-square, W. 1, have designed and placed on the market a barometer which is claimed not only to obviate these



LOWER END OF IMPROVED BAROMETER

defects, but to be much more convenient to set and to read, to be more robust, and to be capable of being cleaned by the user without dismantling, or in any way interfering with its accuracy or normal working. In this new instrument—illustrated herewith—the cistern is made of iron, the glass mercury tube being held firmly at its upper end by a ball and socket joint, which allows the tube to take up its position in the centre of the metal frame quite free from strain. The screw A is used for setting the surface of the mercury into contact with the zero point. This point is made from rustless steel and is firmly screwed and keyed into the metal frame, and, therefore, at an invariable distance from the divided scale. A filter B is provided to purify the air, which is drawn in and expelled from the cistern as the mercury rises and falls. This filter is designed to keep the mercury surface clean and free from impurities for an indefinite time, even in the trying atmosphere of a chemical laboratory. It also allows the air to circulate quite freely into and out of the cistern, so that the setting by the screw A becomes quite dead beat, and no time is lost, as in the old pattern, in waiting for the mercury to settle down to its proper level.

The measuring cistern may be emptied of mercury by lowering the screw A, and as it is again raised, the mercury percolates through a small hole in the base, which has the effect of removing any floating impurity. The cap C may be unscrewed at any time without even removing the instrument from its hook. Its removal allows the cistern to be cleaned out and fresh mercury introduced should it ever be necessary to do so. The reading of the point and its reflected image is viewed by means of an optical system, which gives very perfect definition under considerable magnification. The mercury surface may, therefore, be brought up into contact with the measuring point with great accuracy and ease. Light enters the measuring chamber through an optically plane disc fixed to the back of the cistern, is reflected from the mercury

surface and then viewed through the magnifying ocular D. The field of view is brilliantly illuminated by properly collimated light, and the point and its reflection are so clearly defined that settings can, the makers claim, be repeated with an accuracy hitherto unobtainable.

The adjustment of a barometer to the truly vertical position is of considerable importance. This adjustment can be very readily effected in the new instrument, as it is only necessary when setting it up on the wall to rotate the frame about its vertical axis and adjust it by means of the three screws at the base, until the point makes contact with the mercury in all positions.

Canadian Engineering News.

St. John Harbour Improvements.

WORK is about to begin in real earnest on the building of a large ocean pier at St. John, New Brunswick. A large amount of contractor's equipment has been set up and prepared for action. This equipment will be used on excavating work within a cofferdam, protecting the large area of West St. John, where upwards of 5,000,000 dollars is being spent in the initial undertakings to provide the harbour with a great ocean pier, a large grain elevator, conveyor galleries to handle the grain to the vessels, new transit sheds, &c. The new grain elevator, designed to hold 1,500,000 bushels of wheat as an initial unit in the port's new grain handling facilities, is now nearing completion, as well as the car dumping shed, the latter located in the centre of the railway yards, whence the grain will be conveyed on belts travelling some 800ft. Immense new railway yards and development of industrial sites are included in the plans of the St. John Harbour Commission. The new pier, which is first to be 850ft. in length and later increased to 1250ft., will greatly alter the appearance of St. John Harbour and considerably increase its capacity for handling the growing ocean commerce.

Canadian Platinum Metals.

Canada is beginning to occupy an important place in the world supply of the group of platinum metals. In 1928, when the Dominion stood third in the world's production of these metals, the production of platinum in Canada was 10,532 oz., valued at 708,909 dollars; while that of palladium, rhodium, iridium, &c., was 13,607 oz., with a value of 627,833 dollars. In 1930 Canadian production of platinum was 34,113 oz., valued at 1,542,761 dollars; while the output of palladium, rhodium, iridium, &c., in that year was 34,063 oz., with a value of 895,040 dollars. Most of the production of these metals in Canada comes from the refining of nickel-copper matte from the Sudbury district. Minor quantities of platinum are obtained from British Columbia placers, and some platinum and palladium are recovered from ores worked by Consolidated Smelters, at Trail, British Columbia.

Gas Distribution.

The cities of Port Arthur and Fort William, at the head of the Great Lakes, have concluded negotiations granting a concession to the Hamilton Coke Ovens and By-Products Company, of Hamilton, Ontario, for the distribution of gas in the twin cities. It has been intimated that the company will spend 2,000,000 dollars in the first year. A gas and coking plant is to be erected, and the laying of gas mains undertaken, neither of the cities at the head of the Lakes having any distribution system at present.

Welland Ship Canal.

The new Welland Ship Canal, connecting Lake Erie with Lake Ontario, though not fully completed, has already begun to exert a radical influence on the type of shipments to Lake Ontario ports from points on the upper lakes. The first shipment of iron ore to be moved entirely by water from a Lake Superior port for the Steel Company of Canada, arrived recently by the large lake cargo ship "Collingwood," which, in addition to being the first steamer to carry ore to Hamilton, was also the largest cargo carrier ever to enter the port. The vessel is 386ft. long, and with her full cargo of 6000 tons, draws 18ft. of water, the maximum draught which the Welland Canal at present allows.

Manitoba as Gold Producer.

Gold production in the province of Manitoba for the first four months of the current year amounted to 35,928 oz., valued at 739,540 dollars, or at a rate well in excess of 2,000,000 dollars annually, as compared to an output of 23,189 oz., valued at 479,359 dollars for the whole of 1930. At the present rate of production the province is likely to replace the Yukon as the fourth producer in all Canada.

Progress on Hudson Bay Terminus.

Work on the 2,500,000-bushel elevator and docks at Churchill, the northern terminus of the Hudson Bay Railway, is well under way. The steel fabric of the new elevator is progressing rapidly, and the brick walls of the elevator's power-house were already up by the end of June. The harbour work proper is being carried on simultaneously, and this summer about 900ft. of dock will be added to the 700ft. constructed last year.

Big Water Power Undertaking.

The 3½-mile dam across the Ottawa River at Chats Falls, the site of a future 224,000 horse-power hydro-electric development, is about two-thirds completed. When the remaining gap is closed, it will provide a normal head of 53ft. of water for operation of the plant. Two generators with their accompanying water wheels are well on their way to completion. Each will have a rating of 28,000 horse-power. Eight units will comprise the initial installation, while the ultimate capacity is 280,000 horse-power in ten units.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

More Hopeful Tone.

SOME restoration of confidence has been inspired by the formation of the new Government, which, it is believed, will take prompt and, if necessary, drastic action to restore national financial stability. In Midland and Staffordshire industrial circles this week a much more hopeful tone has been in evidence. Suspense has been to some extent relieved, and portents in the iron and steel market were considered more favourable to trade expansion. Naturally under existing conditions the market is cautious, but there is some movement discernible in business which, after recent weeks of stagnation, encourages hope. At date, consumption of iron and steel is at a low level, activity in most of the consuming works being limited to little more than half time. Users in this area are not prepared to cover themselves beyond visible requirements, and the small tonnage orders given out can in most cases be readily supplied from stock. There have been no market movements of importance during the past week.

Pig Iron Prices.

After a careful review of the market and trade situation, the Central Pig Iron Producers' Association has again reaffirmed minimum selling prices. Though there has been a little freer buying of pig iron in recent weeks, and some Midland furnacemen report the receipt of orders of a more encouraging nature than have been coming to hand of late, there is not sufficient evidence to justify the assumption that trade is definitely on the mend. Forgemen and foundrymen still consider the existing range of pig iron prices too high, but few, if any, of them had looked for a reduction in the basis at this time. The present curtailed production is about equal to consumptive requirements, and although stocks at some of the furnaces are large, they are not being added to. Prompt deliveries of all grades of iron being obtainable, foundrymen see no necessity to arrange contracts. There is no improvement in activity at the forges and foundries in this area. Pig iron prices as reaffirmed for this zone are:—Northamptonshire forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d. Derbyshire forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s.—delivered at stations in the Black Country and subject to rebate.

Staffordshire Iron.

There has been no improvement during the week in the Staffordshire finished iron trade, and the proportion of unemployed resources at the mills remains disappointingly large. Marked bars sell regularly but in small tonnages at the fixed price of £12 per ton at makers' works. Ironmasters continue hopeful of a development of business towards the end of the month, while they are also counting upon increased support from the railway companies in the near future. In the latter case, however, much depends upon whether the companies consider it wise with declining revenues to embark upon schemes of development. Business in Crown and common bars is bad, and there is keen competition for the few orders which come on to the market. Prices continue irregular. Some Staffordshire ironmasters quote Crown bars as high as £10 per ton, while supplies from other districts are available at £9 5s. Nut and bolt and fencing quality bars range in price from £8 5s. to £8 10s. Wrought iron gas tube strip is upheld at £10 12s. 6d., but buyers are holding off the market in the hope of better terms. Local strip mills are only moderately employed.

Steel.

The steel market has undergone little change. Consumers confine transactions to immediate needs, and these are not large. Producers of sections and plates complain of the scarcity of specifications and orders. They are satisfied, however, that the operation of the rebate scheme prevents business of any consequence going to foreign competitors. Angles sell at the fixed price of £8 7s. 6d., less 15s. rebate to users of British steel only. Tees are £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge, and tank plates, £8 17s. 6d., less 15s. Boiler plates are steady at £9, as are Staffordshire hoops at £9 10s. It is difficult to determine market values of semi-finished material. Continental houses are cutting prices, and local steel works eager to keep business in this country are not sticking fast to recognised quotations. It was stated on 'Change in Birmingham this week that small bars of British make were to be had at £6 17s. 6d., although the general quotation remained at £7. Similarly, small bars rolled from imported material, although generally named £6 7s. 6d. per ton, could be bought from certain sources at 1s. per ton less. Mild steel billets command £5 upwards. Continental steel was offered this week at £3 17s. 6d. for billets, £4 for sheet bars, £4 9s. for small bars, and £4 10s. for No. 3 iron.

Galvanised Sheets.

A further fall of half-a-crown per ton in galvanised sheet prices has taken place as a result of the "scramble" for business. Corrugated sheets of 24 gauge are this week quoted for export at £9 per ton. Demand is about maintained at recent improved levels, but overseas markets are not buying with any degree of freedom, and although makers consider present values unremunerative, they are anxious to keep mills running. Prices of material to be consumed at home show no change on the week.

Pottery Fuel Shortage.

The Wolstanton Colliery, Stoke-on-Trent, having closed down on Thursday last week owing to the exhaustion of the monthly quota, a fuel shortage leading to the closing down of pottery works developed. Following the closing of the colliery, Messrs. Johnson Brothers, of Hanley, closed down five factories, owing to shortage of suitable fuel, rendering idle 2500 pottery operatives. Fourteen other pottery firms have had to restrict their output in consequence of the closing of the colliery. Protests made to the Board of Trade and the Mines Department are expected to result in arrangements being made to prevent any repetition of the difficulty. Since a new quota came into operation on the 1st inst., the position has been temporarily, at any rate, relieved. The pottery firms concerned state that they cannot use fuel from other collieries because of the great losses which might be involved through ware in the ovens being spoiled. On the other hand, it is asserted that supplies of the same grade of fuel as that raised at the Wolstanton Colliery are available from other collieries in the district.

Iron Roads.

The Streets Committee of the Worcester City Council proposes as an experiment, subject to the sanction of the Council, to lay a certain section of road, 1200 square yards, with iron plates. These plates are made by the Stanton Iron Company specially for constructing iron roads, and a sub-committee from Worcester has inspected an experimental road surfaced with the new material near Nottingham. The section of road it is proposed to lay carries the heaviest traffic in the city, and is already treated with a special form of surface. The cost of the iron surface is put at about £1200. The city surveyor reports that if not successful the company would re-make the street.

Steelwork Contract.

It is announced that E. C. and J. Keay (1926), Ltd., of Birmingham, have been awarded a contract for steelwork required for the new rolling stock depôt which is shortly to be erected on the new westerly extensions of the Piccadilly Railway. As the depôt will be capable of accommodating 300 cars, it is obvious that a large quantity of steelwork will be necessary in its construction.

Unemployment.

A further decrease in the number of persons unemployed in the Midlands area is recorded in the latest statistics. The present total of 400,074 is 12,650 lower than that recorded the previous week, but the number is higher by 110,010 than it was in the corresponding week last year. Of the total workless, 269,352 are men, 111,580 women, 10,039 boys, and 9103 girls. The position in Birmingham grows steadily worse, a further increase in unemployment having taken place this week. The latest figures for the area—75,385—are nearly 700 in advance of those of the previous week and over 1000 higher than a fortnight ago. A substantial decline has taken place in the Stoke-on-Trent area, the figures having fallen in a week from 41,710 to 38,845. Decreases are likewise fairly general in the large towns in the Midlands and in the Black Country industrial areas. Exceptions are Smethwick and Walsall.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

"Regenerative" Tramcar on Trial.

AFTER a series of tests conducted by the Manchester Corporation Transport Department, trials of what is described as the "regenerative" type of electric tramcar were carried out under ordinary conditions of road service on Friday of last week. The motor fitted to the experimental vehicle, which was operated on the Manchester-Oldham route, was made by the Metropolitan-Vickers Electrical Company, of Trafford Park, and is of such a type that when the tramcar is braked at a stop it generates electrical energy which is returned to the power station through the overhead wires. The Manchester tests are being carried out on behalf of the Municipal Tramways Association, and interest in them extends over a much wider area than Lancashire itself. Up to the present, however, no official announcement has been made as to the results. Whether or not it will ultimately be generally adopted here remains to be seen; but it is estimated that the employment of the new type of motor on the Manchester system would mean a saving on electric current of between £35,000 and £40,000 a year.

Electricity Developments.

The extensions that are being made to the Hartshead power station of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board are now estimated to cost £176,000. Originally, the Electricity Commissioners sanctioned the borrowing of the sum of £130,000, but the Board has decided to apply to the Commissioners for permission to borrow a further £46,000, which, it is explained, is necessitated by the increased capacity of the plant and the additional requirements of the Commissioners. The £100,000 electricity development scheme of the Irlam (near Manchester) Urban District Council, which is sponsored by the Stretford and District Electricity Board, is not expected to be completed before next January. By far the biggest consumer will be the Lancashire Steel Corporation, whose extensive works are situated in the area.

Wages and Salaries.

Following upon the recent reduction of about 6 per cent. in the piecework rates of workmen employed by the Metropolitan-Vickers Electrical Company, Trafford Park, it is announced that, dating from the beginning of October, a reduction of 5 per cent. in the salaries of the entire staff of the company is to be put into operation.

Non-ferrous Metals.

Steady to firm conditions have been in operation in most sections of the non-ferrous metals market during

the past week, with tin still the chief centre of interest. This is due, primarily, of course, to the publication of the plans of the Tin Pool for the regulation of the supply of the metal in relation to the demand, and it is perfectly plain that, for the present at all events, the market is disposed to take a more serious view of the new scheme than it has of previous ones. There is still a long way to go before the "release" price of £150 which has been established by the Pool is reached, but a further advance on balance, this time to the extent of rather more than £3 a ton, is indicative of current market sentiment. The demand for the metal during the past week has been fairly active, with, however, probably the bulk of the tonnage involved accounted for by speculative transactions. So far as copper is concerned, the process of recovery from the "record" low price levels is an extremely slow and laborious one, and in spite of the fact that fractional increases have occurred for three weeks in succession, values at the moment of writing are only just back to where they were at the end of July. The undertone in respect of copper seems to be a shade more hopeful, but here, again, sales have been largely of a speculative character, partly in the hope of better conditions at the manufacturing end before long. Compared with a week ago, standard brands are dearer by about 7s. 6d. a ton. Lead has lost the greater part of the previous week's advance, and the demand is on quiet lines. The rise in spelter has been followed by very slight reaction, but the market is still reasonably steady and the undertone rather more hopeful than it has been for some time.

Iron and Steel.

Indications of a certain measure of autumn revival, relative, it may be, after the holiday dullness, have been in evidence on the iron and steel markets here since my last report. Quotations for pig iron have kept steady and more interest from users has been reported, although there is still a pronounced tendency, except in a few isolated instances, for actual orders to be limited to requirements over a comparatively short period. For delivery equal to Manchester, Staffordshire, Derbyshire and Cleveland makes are quoted at 67s. per ton, Northamptonshire at 65s. 6d., Scottish at about 86s. 6d., and West Coast hematite at 81s. The steel requirements of Lancashire structural engineering firms are still far from satisfactory, but in several other directions, although contract buying is as rare as ever, the orders that have been placed with rollers during the past week have been heavier in the aggregate. A moderate amount of interest has also been shown in special alloy steels. Large diameter bars are firm at £9 7s. 6d. per ton, sections at £8 7s. 6d., joists at £8 15s., general plates at £8 17s. 6d., boiler plates at about the same figure, and small re-rolled bars at £6 10s. More buying has also been experienced in respect of imported steel materials of the finished class, users, apparently, being prepared to take advantage of the extremely low rates now prevailing. Continental billets and sheet bars have weakened to about £3 12s. 6d. per ton, delivered in the Manchester district, with steel bars, joists and angles all quoted at £4 5s., Siemens plates at £5 9s. to £5 10s., Thomas plates at £4 18s., and No. 3 Belgian iron at £4 6s. 6d. to £4 7s. 6d.

BARROW-IN-FURNESS.

Hematites.

There is stagnation in the hematite pig iron trade of North Lancashire and Cumberland. With the blowing out of the furnace at Ulverston last week, iron is now only being produced at Millom and Workington. A continued weakness is the absence of any local demand from steel makers. Trading is from hand to mouth. At Barrow sales are taking place from stock. All through the district heavy stores are held. There is a small demand for hematite iron ore. Importation of foreign ore has been very quiet for some time. In the steel trade there is idleness at Barrow and Workington, so far as the production of rails is concerned, for there is no business on offer, either on home or overseas account. The hoop mills at Barrow are engaged on rolling hoops, strips, &c. Vickers-Armstrongs, Ltd., have completed the fitting out of the P. and O. liner "Strathnaver," and she has left Barrow for her trials on the Clyde. She is of 22,000 tons, and is fitted with an electric drive operating twin-screws.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

THE condition of the heavy steel trade, in this district and also in North Lincolnshire, shows no improvement. The number of furnaces in operation remains at an abnormally low level, and it is difficult to find an outlet for their production. Most of the orders are individually small, and inquiries lack that substantial character which would indicate a prospect of revival. Heavy engineering is very quiet, and the railway steel departments are also extremely short of work. There is an expanding demand in certain special lines, and the outlook in these directions is regarded as promising. There is a fair home demand for special steel, but sales to the Continent show a further decline. Stocks of tools in the Colonial markets must have reached a low level, as purchases during the last twelve months have been much below consumption. It is considered likely, therefore, that replenishments will have to be undertaken soon. In a few cases these markets are now calling for Sheffield products rather more freely, but the improvement is not pronounced yet. There is general quietude in overseas markets, extending to South America and the Near and Far East. In spite of the unsatisfactory nature of the position a feeling of confidence in the future is beginning to show itself.

Russian Orders for Stainless Steel.

Among so many quiet departments, that of stainless, heat and corrosion-resisting steels stands out as one of the few that are enjoying a good share of activity. The home demand keeps up well, although it has not shown signs of expansion recently. Thos. Firth and John Brown, Ltd., have just booked orders for stainless steels for the Government of Soviet Russia, amounting in value, it is stated, to about £20,000. Most of the material is intended for turbine blades. There is also a prospect of further substantial orders coming to Sheffield for other classes of corrosion-resisting steels and alloys. Russian orders are on hand for files and other classes of tools, but the quantities are not large.

Sheffield Aerodrome.

Sheffield is not to become a commercial air port yet. Although in the words of Sir Alan Cobham, "very few cities of the size and importance of Sheffield have the opportunity to construct an aerodrome so close to their centres," and although he strongly recommends the development of the Coal Aston site for this purpose, the Parliamentary and General Purposes Committee of the Corporation recommends that, in view of the prevailing financial conditions, consideration of the matter be deferred for the present. Although the question is thus to be shelved, some interesting points in the report may be mentioned. It was at Coal Aston, about 4 miles from the centre of the city, that the Government established an aerodrome during the war. Sir Alan states that the site would need to be enlarged and improved, and he estimates that £3000 spent on the first stage of the improvements would make it ready for a licence and available for general air traffic. The second stage consists chiefly in enlarging the area and levelling, and he estimates that the cost would not be great. The third and fourth stages include the construction of a new road to the south, and the removal of an existing lane. The Estates Surveyor reports that Sir Alan's recommendations would make the final site an area of 248 acres, 190 acres of which are the property of the Corporation. The estimated cost of acquiring the additional 58 acres is £5000, but probably £2500 would suffice for the development of the first stage. The total estimated cost for the four stages would be £25,225, and as the Corporation has already spent £30,906 on the acquisition of land at Coal Aston, the total expenditure would be £56,131.

Colliery Developments.

One of the colliery developments in progress in this district at present is that of the Sheffield Coal Company, Ltd., at Brookhouse, near the city. At the annual meeting of the company last week, the chairman reported that the new shaft at Brookhouse had reached coal, and, as a shaft, was complete. The winding engines and headgear had been installed, and the company was proceeding with the development of the Thorncliffe seam, the output of which was being wound at Beighton until the development had reached the stage when it would be considered economical to equip and wind from the new shaft. He added that the new coke-oven and by-product plant had been in operation for over a year, and had been run at a considerable saving in cost as compared with the old ovens at Beighton. Unfortunately, however, now that the company was in a position fully to take advantage of this enterprise, the coke market had gradually got worse, and had weakened to such an extent as to make it necessary to close down the old ovens at Beighton.

A New Colliery Locomotive.

An all-battery locomotive for underground haulage has been introduced by Greenwood and Batley, Ltd., of Leeds, for which are claimed several advantages. Its height is only 3ft., but it has great drawing power in relation to its size. It is 38in. wide with a 24in. gauge, has an overall length of 9ft. 7in., and can take a 30ft. radius curve. Its weight is about 3½ tons. It is driven by two 8 H.P. motors, and will draw on a level road a load of 30 tons, using tubs with plain bearings, or a load of 60 tons in tubs having roller bearings. The locomotive is fitted throughout with ball and roller bearings. Power is obtained from a battery of 390 ampère-hour capacity. There is sanding gear to all the four wheels, and powerful hand brakes sufficient to stop the locomotive and the loaded train in a very short distance. The track is illuminated by powerful headlights of over 100 c.p. One of the advantages claimed for the locomotive is its usefulness in displacing ponies in mines where zigzag roads make rope haulage impracticable. Another is that, where rope haulage is in use, loss of working time can be obviated if the locomotive is employed for the transport of labour in mines where the coal face is at a considerable distance from the shaft. The first of these locomotives are for Scottish mines, where naked light conditions obtain, but it would only be necessary to make minor alterations in order to make their use possible in Yorkshire and other coalfields where the mines are of a more gassy character. They are fitted with flameproof motors and a controller of a type approved for mines.

Cutlery and Plate.

The cutlery and plate branches are but moderately employed. Although the output of several classes of cutlery is large, it is much below capacity of production, and complaints of slackness are general. It is stated that the quantities of table knives being disposed of by the principal cheap bazaar houses exceed 6000 dozens per week. There is, however, considerable competition for this trade. In other sections, also, rivalry is very keen, and price-cutting is making much of the business unremunerative. Contracts for table ware for hotels and restaurants provide a very useful amount of work, but the number of shipping contracts on hand is below the average, and sales to holiday and health resorts during the summer have been considerably less than those of a year ago. Business is sluggish in the best qualities of cutlery and plate. The low price of silver has not stimulated the demand for hollowware, but has led to increased sales of spoons and forks. An interesting innovation in the cutlery trade is the manufacture of electrically operated scissors, the rights of which, for the British Empire, China and Japan, have been acquired by Joseph Rodgers and Sons, Ltd. There are four models, and they are suitable for all industries using almost any kind of fabric—leather, sheet tin and lead. They are made to use A.C. of from 200 to 240 volts. Messrs. Rodgers have laid out a considerable portion of their premises for the manufacture of the machine, and they will soon be in a position to turn out any quantity up to 100,000 a year. The trade in safety razor blades, as a whole, is not by any means good, although several makers continue to book substantial orders from home and Colonial buyers. Great quantities of very cheap blades are being exported from the Continent.

The Cutlers' Company.

The new Master Cutler of Sheffield, who was elected on Monday, is Mr. Joseph Ward, chairman of Thos. W. Ward, Ltd., a firm which occupies a leading position in the ship-breaking, metal and machinery, and other industries. The new Senior Warden is Lieut.-Colonel A. N. Lee, director of Walker and Hall, Ltd., cutlery and electro-plate manufacturers, and the Junior Warden is Mr. C. J. Walsh, managing director of Ibbotson Bros. and Co., steel manufacturers. The Cutlers' Feast is to be held on November 5th, when the chief guest will be Lord Amulree, Secretary for Air.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

THERE is a more hopeful feeling abroad in commercial circles in the North of England, and especially in the iron and steel trade. More inquiries are circulating, a few orders have, in fact, been placed, and it is confidently believed that if the financial situation be stabilised, business will now begin to expand, as many consumers are known to be short of stocks. A revival in the export trade is badly needed. During August, the shipments of iron and steel from the Cleveland district were the lowest recorded since the coal strike in 1926. Whether bottom has been reached time will prove. Autumn, however, is usually a period of expansion, but it remains to be seen whether orders will be forthcoming to avert a still more serious industrial decline. It is encouraging to note that exports of pig iron to foreign destinations increased from 2831 tons in July to 4390 tons in August; but, on the other hand, coastwise shipments fell from 7320 tons to 3992 tons, so that the aggregate was no more than 8382 tons, compared with 10,151 tons in July. Manufactured iron and steel shipments also represented the smallest tonnage since 1926. Of the total of 27,028 tons, which compares with 32,842 tons in July, 9889 tons went coastwise and 17,139 tons to foreign ports.

Cleveland Iron Trade.

Although there are now only six blast-furnaces producing Cleveland pig iron, stocks are being slightly increased. It would, however, need little expansion in demand to bring about withdrawals. The market position is improving. Deliveries to Scotland have now been resumed, and notwithstanding the offer of cheaper imported iron, Cleveland is getting a share of the orders from Scottish foundrymen. Locally, deliveries are on a restricted scale, but prices are firm and unchanged. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite pig iron producers are also hampered by heavy stocks. A few sales to Midlands and Sheffield consumers are reported this week, but supply still exceeds demand, and quotations of 61s. for mixed numbers and 61s. 6d. for No. 1 quality can be shaded.

Ironmaking Materials.

There is no business passing in foreign ore, and 14s. 6d. c.i.f. Tees is purely a nominal quotation for best Rubio ore. Good medium blast-furnace coke is a trifle firmer at 15s. delivered at the works.

Manufactured Iron and Steel.

Inquiry has not developed to any appreciable extent in the various branches of the manufactured iron and steel trade, but the prospects in sections producing shipbuilding requisites are just a shade better, owing to reports of possible orders for vessels. The departments turning out railway material have contracts to complete, but new work comes forward slowly. Further orders for constructional steel are reported, and in this section activity at the works is assured for some months. Prices are all unchanged.

Another Liner for Conversion.

The "Stuart Star," another of the Blue Star liners, is expected in the Tyne shortly to undergo conversion from coal to oil-burning equipment at the Walker Naval Yard of Vickers-Armstrongs. She has a gross tonnage of 10,646, and was built and engined by Palmers at Jarrow in 1926. The "Afric Star," a similar ship belonging to the same line, has already been at the Naval Yard undergoing similar alteration. The "Stuart Star" is a twin-screw steam-driven turbine ship.

The Coal Trade.

The Northern coal trade is still lacking in new features of moment. Fitters were not sorry to see the end of August. It is always a very quiet period, and its usual characteristic prevailed this year. Towards the close there was the customary slight movement in house coal, and large steams were in more regular demand. Other classes of fuel remained quiet. Inquiries from abroad were limited, and home business was still the mainstay of most of the collieries in the two counties. Some Northumberland collieries have entered upon the third month of the quarter at the quota mark, and with the

prospect of idle time. When they reach the limit of output —73 per cent. of the standard tonnage—they cease to draw coal, and do not risk the penalty of 2s. 6d. per ton, as they did earlier in the year, for all coal produced in excess of the allowance. It means a good deal of unemployment, but this cannot be avoided so long as pits are restricted in their trade. No two collieries are exactly alike, either in the quality of their product or in their business connections. In the Northumberland steam coal trade there is an improved demand, and as the output of many of the most favoured brands is being curtailed, owing to the operation of the quota, the undertone is steadier, and, although no actual advance in price is recorded, the tendency is for prices to move against the buyer. The Swedish State Railways have invited tenders, which are due on September 12th, for the supply of 48,000 tons of steam coals for shipment in October and November. Poland will, of course, be a formidable competitor, that country's price being quite 2s. per ton lower for the top qualities. If, therefore, this district is to get any share of the contract, it will not be owing to a favourable price. Best Northumberland steam coals are offered at 13s. 6d. and seconds at 12s. Stocks of small steam coal are excessive, and obtainable at as low as 8s. 6d. Tyne prime steams are sparingly offered, both large and small, at 12s. 9d. and 9s. respectively. The Wear special steam coal trade is dull, fitters having difficulty in clearing the current output. Prices are unchanged, large being 15s. and small 12s. In the Durham coal section the prospects for September are not encouraging, the approach of colder weather and longer nights having so far given no sign of stimulating the demand for gas coal, which remains slow and easy in tone. Best qualities are plentiful at 14s. 6d., and seconds 13s. 6d. Coking classes are in abundant supply and moving slowly, unscreened at 13s. to 13s. 3d., and coking small at 12s. 6d. to 12s. 9d. Bunker qualities meet with a fairly active demand, and are quoted steadily at 13s. 6d. to 13s. 9d. Secondary kinds, however, are neglected and nominal at 13s. The export coke position is better, inquiries for winter supplies being on a large scale. Ordinary patent foundry coke is firmer and producers report a large volume of orders. Prices range from 15s. to 16s. Gas coke is moving more rapidly too, but prices are unchanged.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THROUGHOUT the month of August only one vessel was launched on the Clyde. This vessel, the "Carthage," was built for the P. and O. by Alexander Stephen and Son, Ltd., Linthouse, and is of 14,000 tons gross. For this year to date the tonnage launched from Clyde yards amounts to forty-three vessels of 134,412 tons, compared with 144 vessels of 384,549 tons in the same period last year. Last month was one of the best this year in respect to new orders. The Port Glasgow area has been most favoured, as four orders have been placed there, two for vessels of 9000 tons, one of 6000 tons, and a dredger. Messrs. Denny will build a cargo steamer for the L.M.S. Railway's Holyhead–Dublin service. In addition, two coasting vessels will be built at Bowling, and a pontoon barge at Govan. The last-named will be 150ft. long, and will be used for service in South Africa. Local marine engineers will benefit from these contracts.

Steel.

There is a slightly better feeling in the heavy steel section, due in a measure to the new shipbuilding orders already referred to. Outputs of steel are still far below aggregate capacity, and though some benefit will probably accrue from the shipping orders, real progress depends on an improvement in world trade. The Japanese demand for light sheets continues, but other foreign markets show little interest in either black or galvanised sheets. A feature of interest has been the renewed inquiry for tubes from overseas. Several important inquiries have been in circulation, and producers are hopeful of some definite business, which would be greatly welcomed in view of the present poor state of order books. At the moment outputs are reckoned to be the lowest for a good number of years past. Prices are all unchanged.

Iron.

Bar iron and steel re-rollers are greatly in need of business. Specifications for the former are perhaps a shade more numerous, but the total volume of business is most inadequate. The home price is fixed at £10 5s. per ton, but the export quotation of £9 10s. might be broken for a good order. Re-rolled steel bars, without showing much improvement, have a better outlet than iron, with the home and export price standing at £6 per ton. Business in pig iron is very poor, and prospects are not improved by a further drop in the price of foreign material. Imports continue, a further cargo of 4000 tons having arrived from India.

Scrap.

The market for scrap remains dull and weak, with cast iron machinery at 47s. 6d. and heavy steel at 37s. 6d. per ton.

Coal.

The scarcity of double nuts is still the feature of the Scottish coal market. Steams are fairly steady. Shipping orders as a rule are still only for prompt or early loading, and cargoes are comparatively small. Industrial demands show little expansion, but there is a seasonal movement in household fuel and supplies for gas and electricity works. Prices generally are unaltered, though the tendency is firmer. Aggregate shipments amounted to 213,493 tons, against 194,253 tons in the preceding week and 223,804 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

So far as any development to the advantage of the coal industry of this district is concerned, the conditions of the past week have been disappointing. There has been no special feature about trade generally, or it should be said lack of trade, for insufficiency of business is, and has been for some time, the main feature, and unfortunately there is no sign of any immediate improvement. Paucity of orders and declining freight rates continue to be much in evidence. Certainly shipments of coal and coke were better last week, according to the figures of the Great Western Railway Company, but it has to be pointed out that for the preceding week or two the returns had been extremely unsatisfactory. The actual total was 468,290 tons, which was 81,470 tons above the quantity for the previous week, but as compared with the corresponding period of last year there was a decrease of 72,722 tons. For the current week the outlook is not too promising, as arrivals of tonnage have not been good. At the end of last week the number of idle tipping appliances was thirty-five, with one steamer waiting at Swansea. On Monday the number of idle appliances was reduced to twenty-two, with three steamers waiting; but on Tuesday the position was much worse, as the number of idle appliances increased to thirty-six. From this it is evident that collieries must experience a very difficult period, as there is not sufficient outlet for their production, and short time in the coalfield becomes inevitable. Orders for all directions have unquestionably been unusually scarce, and there have been barely more than one or two orders for steamers carrying more than about 6000 tons. The news from Italy as to its future requirements has not been at all encouraging, while definite information is now to hand that Belgium is introducing a system of import licences similar to that in force in France, in order to curtail the quantity of coal received from other countries. It is stated that the intention of Belgium is to cut down coal and coke imports by 25 per cent. South Wales does not export as much coal to Belgium as the North-East ports, but this district has already suffered considerably, as the figures so far this year show that there has been a fall in shipments to Belgium from round about 250,000 tons to just under 90,000 tons. The action of the Belgian authorities is being closely watched, and representations are being made on behalf of the coal export interests of this country. It is understood that the Belgian import licensing scheme operates from the 1st inst., and will be given a trial, at any rate until the end of this year. One satisfactory item which affects some of the Monmouthshire coals is that the Egyptian State Railways have decided to place with T. Beynon and Co., Ltd., an order for a further 100,000 metric tons on the basis of their last quotation—24s. 1d. c.i.f.—for supplies of locomotive coals to be delivered at Alexandria.

Anthracite Coal Combines.

During the past week fresh rumours have been current regarding colliery amalgamations, this time concerning those producing anthracite qualities. As is well known, the Amalgamated Anthracite Collieries, Ltd., forms the largest existing combine in this area, as the pits under this company's control produce 75 per cent. of the output of anthracite in South Wales. This company disclaims having anything to do with the negotiations which are now said to be in progress, and which concern several other well-known collieries. As a matter of fact, there are about sixteen other anthracite collieries outside the combine, and they produce the remaining 25 per cent. of the anthracite output of this district. One of the most important of these undertakings is the Evans-Bevan group of pits, but the report comes to hand that this concern is not interested in any negotiations for the acquisition of its undertakings. Although no official information can be obtained as to what is actually going on, the report that negotiations are afoot is creating a great deal of interest in West Wales.

Threats of Labour Troubles.

There have been fears of labour troubles at the anthracite pits belonging to the Amalgamated Anthracite Collieries, Ltd., in consequence of allegations that the men had grievances about the payment of the minimum wage. A conference of the workmen was held over a week ago, and there was to be another on Wednesday of this week, when the mandates from the various lodges would be received concerning the recommendation that the men should tender fourteen days' notices to suspend operations. It is questionable whether really serious trouble will develop, as on Monday there was a conference between representatives of the men and the directors of the company. All that was disclosed was that at this meeting there was a very frank discussion of the position, and the men's leaders promised to report to the lodges on Tuesday, and the men's decision would be given at the special delegate meeting to take place on Wednesday. The feeling was that a way out would be found, and that matters would not be allowed to develop into a stoppage of work in this section of the coalfield, which, by the way, is the only one which is working at all regularly.

LATER.

There is to be no stoppage of work in the anthracite section of the coalfield. The special delegate meeting at Swansea on Wednesday received a favourable report of the negotiations with the directors of the Amalgamated Anthracite Collieries, Ltd., and the men decided not to proceed with the recommendation to tender fourteen days' notices. At another meeting the 2000 men employed at the Gwaun-cae-Gurwen collieries also agreed to withdraw the notices which they had given nearly a fortnight ago.

Current Business.

The tone of the steam coal market displays no improvement. The amount of new business coming along is negligible, and all grades of coal with the exception of dry descriptions are easily obtainable for loading in any position. In the case of smalls, collieries have again had to resort to the banking of supplies to enable them to continue the production of other grades. Coke is steady, and patent fuel is moderately well stemmed for early positions. Pitwood is very scarce, and is almost a nominal market. The inquiry for supplies cannot be said to be active by any means, but cargoes of French wood are not being brought along at all freely, with the result that there is a short supply, and prices up to as much as 30s. are quoted by importers for supplies of half and half lengths, but only collieries that are really hard pressed are entertaining buying at such a figure. Others prefer to hold off. Nominally, prices are round about 26s. 6d. to 27s.

THE IRON AND STEEL INSTITUTE.

IN accordance with previous announcements, the autumn meeting of the Iron and Steel Institute will be held at the Royal Metal Exchange, Swansea, on Tuesday, Wednesday, Thursday, and Friday, September 29th to October 2nd.

The following is a list of papers which it is expected will be submitted to the meeting, and, as at present arranged, in the following order :—

First Day, Tuesday, September 29th.

"The Constitution of the Iron-tin Alloys," by C. A. Edwards, F.R.S., and A. Preece.

"The Diffusion of Tin into Iron, with Special Reference to the Formation of Columnar Crystals," by C. O. Bannister and W. D. Jones.

"The Effect of Molybdenum on Medium-carbon Steels containing 1 to 2·5 per cent. of Manganese," by G. Burns.

"The Influence of Silicon on Nickel Steel," by R. Harrison.

Second Day, Wednesday, September 30th.

"Mottled Tin-plates," by J. C. Jones.

"The Equilibrium of Certain Non-metallic Systems," Part I., by J. H. Andrew, W. R. Maddocks and D. Howat; Part II., by J. H. Andrew, W. R. Maddocks and E. A. Fowler.

"Alloys of Iron Research: Part X., The Chromium iron Constitutional Diagram," by F. Adcock.

"The Effect of Surface Conditions Produced by Heat Treatment on the Fatigue Resistance of Spring Steels," by G. A. Hankins and M. L. Becker.

"The Solidification and Crystallisation of Steel Ingots The Influence of the Casting Temperature and the Undercooling Capacity of the Steel," by B. Matuschka.

Third Day, Thursday, October 1st.

"Production Economy in Iron and Steel Works: Part II., Costs of Production," by O. Cromberg.

"The Surface Hardening by Nitrogen of Special Aluminium-chromium-molybdenum Steels on a Production Basis," by W. H. Cunningham and J. S. Ashbury.

"The Structure of Nodular Troostite," by N. T. Belaiew.

"A Critical Study of the Origin of the Banded Structure of a Hot-worked Hypo-eutectoid Steel," by F. C. Thompson and R. Willows.

CONTRACTS.

WAILES DOVE BITUMASTIC, Ltd., of Newcastle-on-Tyne, has been awarded the sub-contract for the application of its "Bitumastic" anti-corrosive materials to the new Cunard liner, now under construction at the Clydebank yard of John Brown and Co., Ltd.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received contracts from the Admiralty for Mazda vacuum and gas-filled lamps, and from the Southern Railway for part supply of Mazda vacuum and gas-filled lamps for the year commencing September 1st, 1931.

ELECTROFLO METERS COMPANY, Ltd., Abbey-road, Park Royal, London, N.W. 10, has secured an order for the complete instrument equipment for the Battersea generating station of the London Power Company, Ltd. The instruments ordered are for the measurement of the boiler and turbine steam, turbo-condensate and circulating water, temperature, pressure, CO_2, steam flow-air flow ratio, draught, &c. The contract also includes a semi-portable Venturi type feed water test metering installation.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

BURTON, GRIFFITHS AND CO., Ltd., Birmingham, inform us that Mr. Paul Siddens, who has for long been associated with B.S.A. Tools, Ltd., has been appointed manager of their London branch at 64–70, Vauxhall Bridge-road. He will be assisted by Mr. J. McDonnell.

MR. DAVID HAMILTON, B.Sc., A.M. Inst. C.E., has been appointed representative for the London area of Birmabright, Ltd., and for Birmal Chemical Engineers. His address will be: Abford House, Wilton-road, Westminster, S.W. 1, and his telephone number Victoria 0932.

MATTERSON, Ltd., Healey Works, Shawclough, Rochdale, has appointed Tom Smith and Clarke, Ltd., of Gower Chambers, Gower-street, Swansea, agents for the whole of its specialities for South Wales, and Mr. Robert Sell, M.I. Mech. E., A.M.I.E.E., 33, Coleys-lane, Northfield, Birmingham, has been appointed its agent for the counties of Warwickshire, Worcestershire and Staffordshire.

PEGSON, Ltd., Alexander-street, Leicester, informs us that under an arrangement with Samuel Pegg and Son (proprietors, Mellor, Bromley and Co., Ltd.), it has acquired from them certain plant and tools for the production of quarry machinery, and also certain stock-in-trade. It will manufacture quarry and road-making machines of the types formerly manufactured by Samuel Pegg and Son, and its products will be sold under the trade mark "Pegson" and other trade marks of Samuel Pegg and Son.

CATALOGUES.

J. AND E. HALL, Ltd., Dartford, Kent.—"Refrigeration and the Manufacture of Ice."

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Catalogue Section 9 dealing with oil pumps of various types.

GILL PROPELLER COMPANY, Ltd., 17, Victoria-street, S.W. 1.—Particulars and capabilities of "Gill" pumps.

HATHORN, DAVEY AND CO., Ltd., Dewsbury-road, Leeds.—General catalogue of pumping and hydraulic machinery.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	14/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 10 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 1 0	3 1 0
No. 1	3 1 6	3 1 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST— N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	5 0 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	9 0 0 to 9 12 6	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/- to 13/3
Block Tin (cash)	120 0 0
„ (three months)	122 10 0
Copper (cash)	32 17 6
„ (three months)	33 16 3
Spanish Lead (cash)	11 6 3
„ „ (three months)	11 10 0
Spelter (cash)	11 10 0
„ (three months)	12 1 3
MANCHESTER—	
Copper, Best Selected Ingots	36 0 0
„ Electrolytic	37 0 0
„ Strong Sheets	66 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	12 15 0
„ Foreign	11 10 0
Spelter	12 2 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 12 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 17 6	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£30 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£35 15 0	13/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	8/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/3
„ „ Splint	14/- to 15/9
„ „ Trebles	12/6 to 13/-
„ „ Doubles	12/- to 12/6
„ „ Singles	10/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/3
Screened Navigation	17/6
Trebles	12/- to 13/6
Doubles	12/6
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/6
Trebles	12/6
Doubles	12/6
Singles	10/-

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	7/6 to 8/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	24/6 to 25/6 —
Derbyshire Best Bright House	19/- to 20/- —
Best House Coal	18/6 to 20/- —
Screened House Coal	17/- to 18/- —
„ „ Nuts	14/6 to 15/- —
Yorkshire Hards	15/- to 16/6 —
Derbyshire Hards	15/- to 16/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/6 —
Smalls	4/- to 5/6 —
Blast-furnace Coke (Inland)	12/3 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 13/- to 14/-	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/3
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/9 to 18/-
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/9 to 20/-
Pitwood (ex ship)	27/6 to 28/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Harbour Works.

THE port of La Rochelle has fallen from its former high estate and is now little more than a fishing port, but it has the advantage of adjoining La Pallice, where there are facilities for extending the harbour to depths such that the largest ships afloat can draw up alongside. La Rochelle-La Pallice has a good geographical position for traffic with Central and South America and West Africa, and it aims at competing directly with Bordeaux, which is building a port of call at Le Verdon at the point of the Médoc peninsula. For some time past preparations have been made to carry out a scheme which dates from 1907 for constructing a viaduct and a mole. An earth embankment has been extended from the outer harbour of La Pallice and will be continued by a metallic viaduct, work upon which was officially begun on Saturday last. This bridge will carry a railway, a motor road and two pathways. The length of the viaduct will be 1120 m., comprising a straight section from east to west on twelve groups of piers 70 m. apart, and then a curved section on seven piers 40 m. apart, which will join it to the mole. The piers will be constructed of metallic caissons that will be floated out and sunk and filled with concrete. When the viaduct is completed work will be started on the mole, which will be 300 m. long and 60 m. wide, supported on piers formed of metallic caissons filled with concrete and carrying arches of reinforced concrete. The railway station on the mole will be provided with every convenience for landing and embarking Transatlantic passengers. It will require about seven years to complete the work.

The Screw Propeller.

Preparations are being made at Boulogne to celebrate the centenary of the invention of the screw propeller, which is claimed to be due to a native of that town, Frédéric Sauvage, who took out a patent in 1831 for a propeller and had to wait ten years before it could be tested otherwise than in small boats with man power. The priority of Sauvage in this invention is challenged, for others had been working on the same problem, and before Sauvage could practically demonstrate his propeller, Smith, in England, had already built the "Archimedes." It may have been the fact that the propeller was beginning to attract notice that induced Augustin Normand, in association with an English engineer, Barnes, to sign a contract with Sauvage to build a ship with the propeller and to have the right to modify the propeller in any way he pleased. Augustin Normand secured an order from the French Government for a ship with a propeller that would be capable of steaming at a minimum of 8 knots. The Sauvage propeller was a complete spiral, which Augustin Normand and Barnes found to be unsuitable, and notwithstanding the inventor's objection to its being changed, they finally evolved the propeller with several blades, which gave satisfactory results on the first screw-propelled ship in France, known as the "Napoleon." All this work was purely experimental, and the builders allowed Sauvage to add the bladed propeller to his patents. Augustin Normand publicly recognised the importance of the inventor's efforts to introduce the screw propeller, and was able to secure for him a small pension, which was all the material advantage that Sauvage or anyone else obtained out of the original patents.

Coal Treatment.

The colliery companies give little publicity to any development work they are carrying out, but for special reasons the Courrières Company deals in its annual report with the methods it is employing for treating coal, which is largely of an inferior quality. The company aims at developing methods and processes that will ensure a complete and economic utilisation of its fuel. Since the chemical firm of Kuhlmann associated itself with Courrières for the formation of a company to produce methyl alcohol and synthetic ammonia from coal, works have been established for the purpose and are declared to be giving remarkably satisfactory results. Then Courrières began experiments with the low-temperature distillation of coal, and is now putting down Illingworth ovens. This process necessitates a thorough washing of the coal, and the company therefore intends to install a coal washing plant of large capacity, which will enable it, at the same time, to supply a clean and graded fuel to customers. The residual slack and unsaleable coal is used in the electrical generating station, which will be extended, and the whole of the coal will therefore be used to the best advantage.

A Burst Fly-wheel.

At the Suresnes waterworks near Paris last week a fly-wheel 19ft. in diameter and weighing 25 tons burst and caused more damage outside the engine-room than within. One piece of the fly-wheel weighing about a ton was projected a distance of 400 yards and fell through a house, fatally injuring a man and causing minor injuries to his wife and child. Damage to the engine-room was limited by the fact that the lower part of the fly-wheel was in a concrete well. After the accident the well was full of broken and pulverised cast iron. While the cause of the accident has not yet been fully ascertained, it is surmised that the fly-wheel accelerated following the failure of a pump valve.

Belgian Coal Licences.

A limitation of coal imports into Belgium is the outcome of the negotiations which have been carried out between Belgian coalowners and the German Köhlen-syndikat for the removal of the embargo upon the importation of Belgian coal into Germany, whereby it was hoped to reduce the stocks that weigh so heavily on the Belgian colliery industry. The negotiations failed so far as concerned the imports of Belgian coal into Germany, but it was arranged that Belgium should adopt the plan that has been put into operation in France for restricting imports and limiting home production. The licence system will remain in operation for four months.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

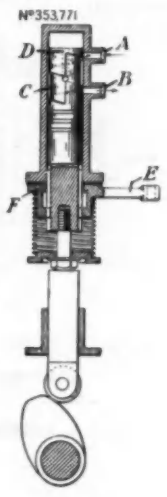
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1*s. each.*

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

353,771. September 26th, 1930.—FUEL INJECTION PUMPS, D. Napier and Son, Ltd., R. W. Vigers and E. E. Chatterton, 211, Acton Vale, Acton, London, W. 3.

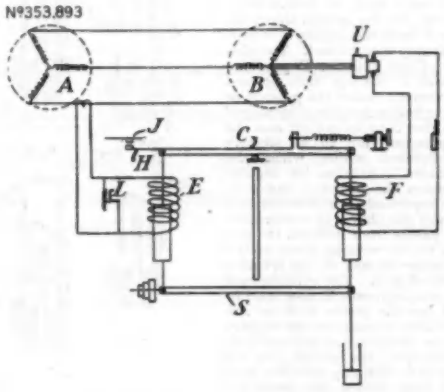
The inlet of this fuel pump is shown at A and the delivery at B. The plunger has a helical groove or recess cut in its surface as shown at C and a hole drilled at D to connect this groove with its upper face. The plunger can be rotated by the arm E, with which it is connected by the splined boss F. On the down stroke of the plunger the barrel is filled with oil from the inlet A. On the up stroke this oil is compressed in the upper part of the barrel as soon as the plunger has masked the port A and finds its way through the hole D into the groove C. It can then pass to the delivery B. As shown in the drawing, delivery has just ceased and simultaneously the top edge of the groove has unmasked the inlet port. During the remainder of the stroke the oil is consequently driven back through the inlet. It will be appreciated that by twisting the plunger the amount of oil delivered can be regulated, on account of the helical formation of the groove C.—*July 30th*, 1931.



DYNAMOS AND MOTORS.

353,893. March 22nd, 1930.—DYNAMO ELECTRIC MACHINES, the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and Henry William Taylor, of "Kilmorie," Old Bilton, Rugby.

One particular application of this invention is in electric ship propulsion systems, where one or more generators are electrically connected to drive one or more propeller motors. In such installations it is necessary for the excitation of the machines to be maintained at the various loads so that power is transmitted electrically between the generators and the motors without risk of instability of operation, and, at the same time, it is desirable that the excitation should not have excessive values, in order that the maximum efficiency is maintained at low loads. A is a three-phase generator supplying a synchronous A.C. propeller motor B. The excitation arrangements for these machines are not shown, but they may both be derived from a common source of current, such as an exciter driven from the shaft of the alternator. The excitation of one or both machines is controlled by means of a vibratory regulator of the Tirrill type, only a part of which is shown in the diagram, the remainder being operated in accordance with customary arrangements. The illustrated part of the regulator comprises a balanced arm C having plungers pivotally connected at its opposite ends and controlled by coils E and F. The arm C carries a contact H co-operating with a second contact J, the contacts serving to control the insertion of resistance into an excita-

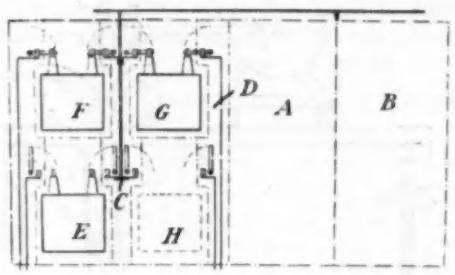


tion circuit of generator A, motor B, or both. The contact J is adapted to be controlled in accordance with the excitation of the generator A or motor B. The energisation of the coil E is controlled in accordance with the current flowing between the generator A and the motor B by means of a current transformer shunted by means of a variable resistance L for the purposes of adjustment. The coil F is energised by a current which is made to be directly proportional to the speed of the motor B, and to this end an auxiliary pilot generator U, having constant excitation is arranged to be driven at a speed proportional to that of motor B and to give an output current which is proportional to the speed of the motor B. The position of the contact H is determined by the relative strengths of the currents in coils E and F. If in a steady sea the speed of the ship is changed and the excitation were maintained constant, the line ampères would fall faster than the speed. The pull of coil F, therefore, predominates, and the arm is tilted anti-clockwise, and this movement tends to reduce the excitation on the machine, and so bring up the line ampères to proportional value. If under steady conditions of speed and with the load varying with the pitching and rolling of the ship, then an increase in load will mean an increase in current. This causes the left-hand end of the arm to be raised and the excitation, due to the closing of contacts H and J, to be increased. The object of the arm S is to maintain the plungers working in the coils E and F, in parallel relationship, despite movements of the ship, and to prevent the plungers touching the interior of the controlling coils.—*July 22nd*, 1931.

SWITCHGEAR.

354,039. July 22nd, 1930.—ELECTRIC SWITCHGEAR, the Metropolitan Electric Supply Company, Ltd., Hugh Lloyd-Williams and Leonard Jocelyn Swan, all of 16, Stratford-place, Oxford-street, Marylebone.

This is a lengthy specification which enters into a great deal of detail which cannot be considered here; but, briefly, the invention relates to switchgear for use on electric supply systems, and it has for object improvements by which various advantages may be obtained. More particularly, it has for object to provide switchgear which may be readily extended when required. The switchgear, comprising cubicles such as A and B, with a number of switches mounted therein, one above the other,



is shown at E, F, G, H. A bus-bar C extends vertically along one side of the cubicle and is connected to corresponding terminals of the switches, and a duct or space is provided at the other side of the cubicle to accommodate cables connected to the other terminals of the switches. Another feature of the invention is concerned with the combination with such switchgear of shields or shutters for the cable terminals, and the bus-bar terminals so constructed and arranged as to be moved into their protecting positions when the isolator switches have been opened. Other features of the invention relate to interlocking means between isolator switches and corresponding shutters, and locking means for the door of a cubicle interconnected with operating means for isolator switches.—*August 16th*, 1931.

TELEGRAPHS AND TELEPHONES.

354,075. August 29th, 1930.—HIGH-FREQUENCY OSCILLATION GENERATORS, Telefunken Gesellschaft fur drahtlose Telegraphie m.b.H., of 12-13, Hallesches Ufer, Berlin, Germany.

In so-called "three-point connected" self-excited valve transmitters for very short waves, the oscillating circuit inductance is generally constituted simply by a loop of wire, which is connected as a potential divider, the anode voltage conductor being in sliding contact with the loop, as shown in the accompanying Fig. 1, which illustrates a typical circuit arrangement of the kind in question. As shown, one end of the loop is connected to the anode and the other end through a blocking condenser to the grid, the grid D.C. voltage being applied through a choke. The anode voltage is applied at A and grid voltage at B. The disadvantage of the connection is that the full grid alternating voltage is always on the grid choke. Since, with very short waves, there is great difficulty in designing really effective

No354,075

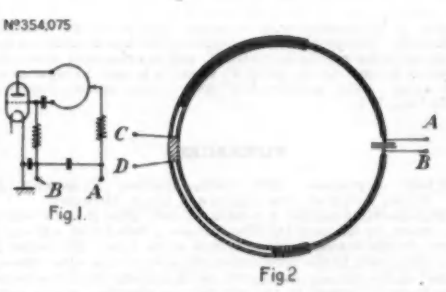


Fig.1. Fig.2

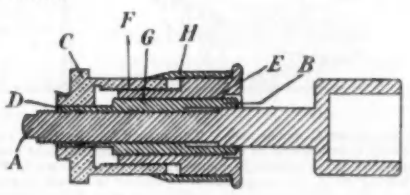
chokes, the grid choke almost always presents difficulty. The invention has for its object to overcome this disadvantage, and to this end the blocking condenser is mounted with the connections for grid and anode chokes in a member which is slidable in another member in such a way that movement of the condenser may be accomplished without altering the tuning of the oscillation circuit. Referring to Fig. 2, the oscillating circuit inductance consists of the circular segments so arranged that one segment can be pushed into the others. The inner segment consists of two parts, which are connected together through a blocking condenser. The anode and grid D.C. voltages are applied at the two condenser terminals as indicated. The anode and grid connections are shown at C and D respectively. By moving the inner segment the blocking condenser, together with the connecting terminals, may be shifted to a point which has substantially no high-frequency voltage without thereby substantially varying the tuning.—*August 6th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

354,006. June 18th, 1930.—TANGENT SCREWS FOR INSTRUMENTS OF PRECISION, H. T. Tallack, 286, High Holborn, W.C. 1.

This device is intended for the very accurate setting of such instruments as theodolites. The tangent screw A is screwed back

No354,006

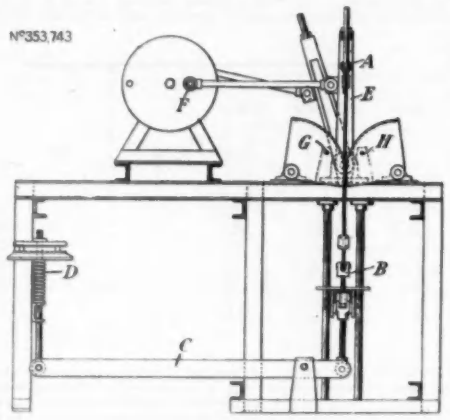


or forth through the bushing B to make the rough adjustment. The bushing is capable of sliding in the box C, but is prevented from turning by a square or other device at D. Between the bushing and the box there is a sleeve E, which is screwed to both parts. The two threads F and G are of different pitches, so

that a differential action is provided for the fine setting of the bushing, and consequently the tangent screw. The reading is taken from the bevelled edge of the sleeve H. It is obvious that practically any degree of adjustment can be obtained by this arrangement.—*August 6th*, 1931.

353,743. September 1st, 1930.—A MACHINE FOR TESTING WIRE ROPES, Smith, Major and Stevens, Ltd., and P. C. Major, Abbey Works, Northampton.

This apparatus is intended to simulate the working conditions of lift ropes and give a rapid means of testing them. The sample

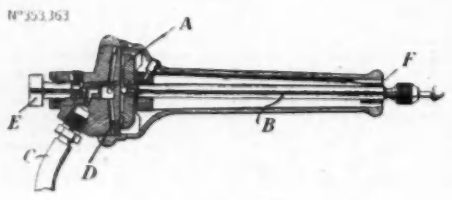


rope is stretched between the grips A and B by the lever C and spring D. The upper grip is fixed on a rocking lever E, which is oscillated by the crank F to bend the rope alternately over the quadrants G and H. The illustration shows a duplex machine.—*July 30th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

353,363. December 1st, 1930.—PNEUMATIC TOOLS, Madison-Kipp Corporation, 201, Waubesa-street, Madison, County of Dane, Wisconsin, U.S.A.

This tool is of the rotary type, intended for such work as grinding, drilling, &c. In the place of the usual reciprocating

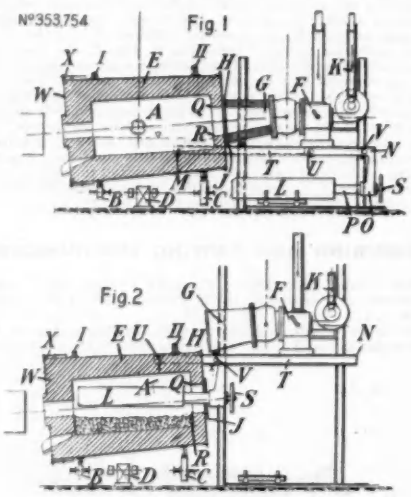


engine, it is provided with a turbine disc A, on the working spindle B. Compressed air is supplied by the hose C to the nozzles D through the regulating valve E, and is exhausted down the stem of the tool to the outlet F, where it is used to blow away the swarf. The specification gives some other details.—*July 23rd*, 1931.

FURNACES.

353,754. September 13th, 1930.—ROTARY FURNACES, E. Weiss, Wethmar, near Lunen a.d. Lippe, Germany.

This smelting furnace A rotates on the rollers B and C which are driven by the gear D. The furnace is fitted with a lining E suited for the materials being melted at the time. The burner F is so connected to the combustion chamber G that after coming to rest on the furnace on the surfaces H J it can rotate therewith. The flame is formed in the combustion chamber, which must therefore be dimensioned according to the fuel employed, and be lined with a refractory fire-resisting lining which does not, of course, need to be capable of resisting either falling or tumbling

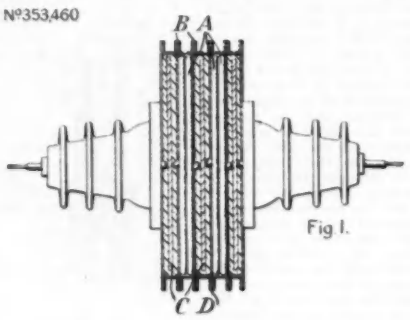


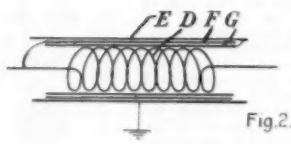
smelting material or the slag. The space for the flame formation being independent of that for the charging, the best possible combustion, it is claimed, is ensured. When, as shown in Fig. 2, the burner with the combustion chamber is raised vertically upwards from the furnace, the fuel supply pipe K fits telescopically into itself. The burner, combustion chamber and the charging trough L are shown as mounted on a conveyor carriage M N O P. When this carriage rises it leaves the large furnace opening Q R free, and the charging trough comes in front of the opening and can be run in. Fig. 2 shows the arrangement during the charging. The charging trough L is still in the furnace, and has emptied out the material by being turned over by means of the wheel S, and, when empty, is again run out of the furnace with the carriage running by means of the wheels U V on the rails T. The running carriage is then lowered and the smelting begins again.—*July 30th*, 1931.

MISCELLANEOUS.

353,460. February 15th, 1930.—LIGHTNING AND SURGE ABSORBERS, Ferranti, Ltd., of Hollinwood, Lancaster, and John Leonard Miller.

The drawing—Fig. 1—shows a multi-section surge absorber constructed in accordance with the invention. Each section normally consists of a flat spiral A of wire contained between two metal plates B, the several sections being joined together to form the complete absorber. Three of the flat spirals of wire are replaced by metal discs C, insulated from the plates B forming the so-called secondary. These discs C are connected electrically to the rest of the absorber circuit and so constitute

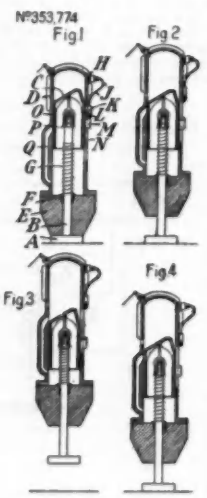




lumped capacities in conjunction with the plates B forming the secondary. According to a modification—Fig. 2—as applied to a surge absorber having a cylindrical winding D contained within a casing E constituting the secondary, the inventors interpose two layers of metal foil F, G, separated by insulation from each other and from the coil. The layer G is connected to the casing—which is earthed—and the layer F is connected to one end of the winding D. Similar layers may be provided and connected to other points on the winding if desired, and the layers or some of them may be disposed within the coil D.—*July 15th*, 1931.

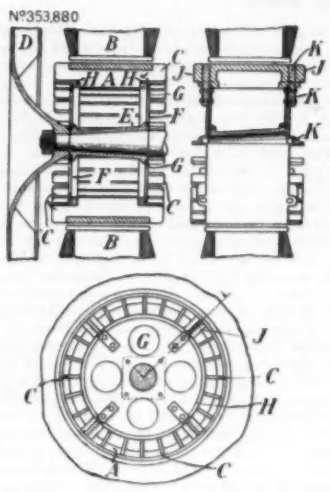
353,774. September 30th, 1930.—PORTABLE TAMPING MACHINES, N. Johnson, Wharfedene, Skipton-road, Ilkley, Yorks.

This tamping or ramming machine is worked by an internal combustion engine. Assuming the parts to occupy the relative positions shown at Fig. 1 with the foot A of the impact tool resting on the ground and a charge of fuel above the piston C to have been just fired, the resulting expansion imparts to the cylinder D and its associated weight or ram E an upward velocity, thereby causing the exhaust opening P to be uncovered by the piston C and allowing the gases to escape. Owing to its kinetic energy the cylinder D and its weight or ram E continue to rise and the upper end of the helical spring G comes into contact with a collar or enlargement on the piston-rod B—Fig. 2—whereupon the piston C and rod B with the foot A begin to rise, but lag behind the cylinder D until the spring G is considerably compressed. The sliding of the cylinder D past the piston C during the upward movement causes the passage of air to below the piston by way of the slot O to be cut off and the imprisoned air to be slightly compressed, whilst when the cylinder D reaches its highest position the piston C uncovers the upper end of the transfer port Q and the charge of compressed air passes from beneath the piston to the working space of the cylinder by way of the transfer port—Fig. 3. The cylinder and its weight or ram E, now start to fall, but the piston with its rod and foot continue to rise slightly under the action of the spring G, whereupon the piston, rod and foot fall with the cylinder until the foot strikes the ground—Fig. 4. The continued downward movement of the cylinder with the weight or ram causes the exhaust opening P to be closed by the piston and the air charge in the working space to be compressed until the ram strikes a heavy blow on the foot which rests on the ground—Fig. 1. Just before the impact of the ram on the foot the projection N on the piston strikes the plunger M of the fuel pump L and thereby causes a spray of fuel to be injected into the working space of the cylinder by way of the valve-controlled nozzle H. At the moment of impact the mixture in the working chamber is fired and the cycle of operations is repeated.—*July 30th*, 1931.



353,880. April 28th, 1930.—EDDY CURRENT BRAKES, E. R. and F. Turner, Ltd., and Francis Hannam Johnson, both of Bull Motor Works, Quadling-street, Ipswich.

The eddy current brake constructed in accordance with this invention prevents the heat generated in the drum being conducted to the shaft and bearings. The rotor drum A rotates in a magnetic field, produced, for instance, by salient poles B. For the purposes of dissipating heat, it is equipped on its ends and inner surface with fins C, some of which are omitted to simplify the drawing. Air is drawn over these fins by a fan D, upon the shaft to which the braking torque is to be applied. To this shaft the hub E of the brake is secured. At the ends of this hub there are discs F, which are reduced in section by openings G so far as is consistent with mechanical strength. Rings H fit within the ends of the fins C, and are placed longitudinally against shoulders on the fins, or they may be cast integrally with the drum and fins. These are machined to fit accurately upon the periphery and against one flat face of the discs F. The drum has a number of bosses J cast at intervals around its circumference, and radial passages inclined to one another are drilled through these to receive accurately fitting dowels K, which are riveted, welded, or otherwise fastened upon the discs



F, or may be integral with them. On account of the relatively small cross section of metal available to the radial flow of heat, the temperature of the shaft and its bearings is not raised to a great extent.—*July 28th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY TO SATURDAY, SEPTEMBER 12TH.

"MODEL ENGINEER" EXHIBITION.—Royal Horticultural Hall, Westminster, S.W. 1. Daily.

SUNDAY TO SATURDAY, SEPTEMBER 6TH TO 12TH.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Congress at Zürich.

TUESDAY, SEPTEMBER 8TH.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London, E.C. 3. Presidential address, by Mr. F. E. Rebbeck. 6 p.m.

THURSDAY TO SATURDAY, SEPTEMBER 10TH TO 26TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, W. Daily, 11 a.m. to 9 p.m.

FRIDAY, SEPTEMBER 11TH.

INSTITUTE OF MARINE ENGINEERS.—At the Shipping, Engineering and Machinery Exhibition, Olympia, W. "Marine Engineering as a Marketing Proposition," by Mr. A. C. Hardy, 3 p.m.; "The History of Marine Refrigeration," by Mr. A. R. T. Woods. 6 p.m.

SATURDAY TO WEDNESDAY, SEPTEMBER 12TH TO 16TH.

INTERNATIONAL FOUNDRY CONGRESS.—Milan.

SATURDAY TO SUNDAY, SEPTEMBER 12TH TO 27TH.

INTERNATIONAL FOUNDRY EXHIBITION.—Milan.

SUNDAY TO FRIDAY, SEPTEMBER 13TH TO 18TH.

INSTITUTE OF METALS.—Autumn meeting at Zürich. For programme, see page 21.

FRIDAY TO SUNDAY, SEPTEMBER 18TH TO 20TH.

NATIONAL SMOKE ABATEMENT SOCIETY.—Annual Conference at Liverpool. For programme, see page 220.

FRIDAY TO MONDAY, SEPTEMBER 18TH TO 21ST.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—At Lady Margaret Hall, Oxford. Eighth annual conference. Friday evening, presidential address, by Professor A. M. Carr Saunders.

WEDNESDAY TO FRIDAY, SEPTEMBER 23RD TO 25TH.

INSTITUTION OF MINING ENGINEERS.—Manchester. Postponed summer general meeting.

FRIDAY, SEPTEMBER 25TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W. Ball. 9 p.m. to 2 a.m.

TUESDAY TO FRIDAY, SEPTEMBER 29TH TO OCTOBER 2ND.

IRON AND STEEL INSTITUTE.—Autumn Meeting at Swansea. For programme see pages 105 and 255.

INSTITUTION OF NAVAL ARCHITECTS.—The Council of the Institution of Naval Architects has awarded the "Elgar" Scholarship in Naval Architecture (1931)—£130 per annum for three years at Armstrong College, Newcastle-on-Tyne—to Mr. H. Lackenby, of R. and W. Hawthorn, Leslie and Co., Hebburn-on-Tyne, and the Earl of Durham Prize to Mr. J. A. Price, of H.M. Dockyard, Sheerness.

JUNIOR SCHOLARSHIP.—The London Chamber of Commerce offers annually two "Charles R. E. Bell Fund" Senior Travelling Scholarships of £150 each, and two "Charles R. E. Bell Fund" Junior Scholarships of £60 each. The successful candidate for the latter, on the results of the Summer (July) Examinations, was Ronald A. Clynes, presented from the L.C.C. Dalston Central School, Lansdowne-road, London, E. 8.